TECHNOLOGY DEPT.

Power Plant ENGINEERING

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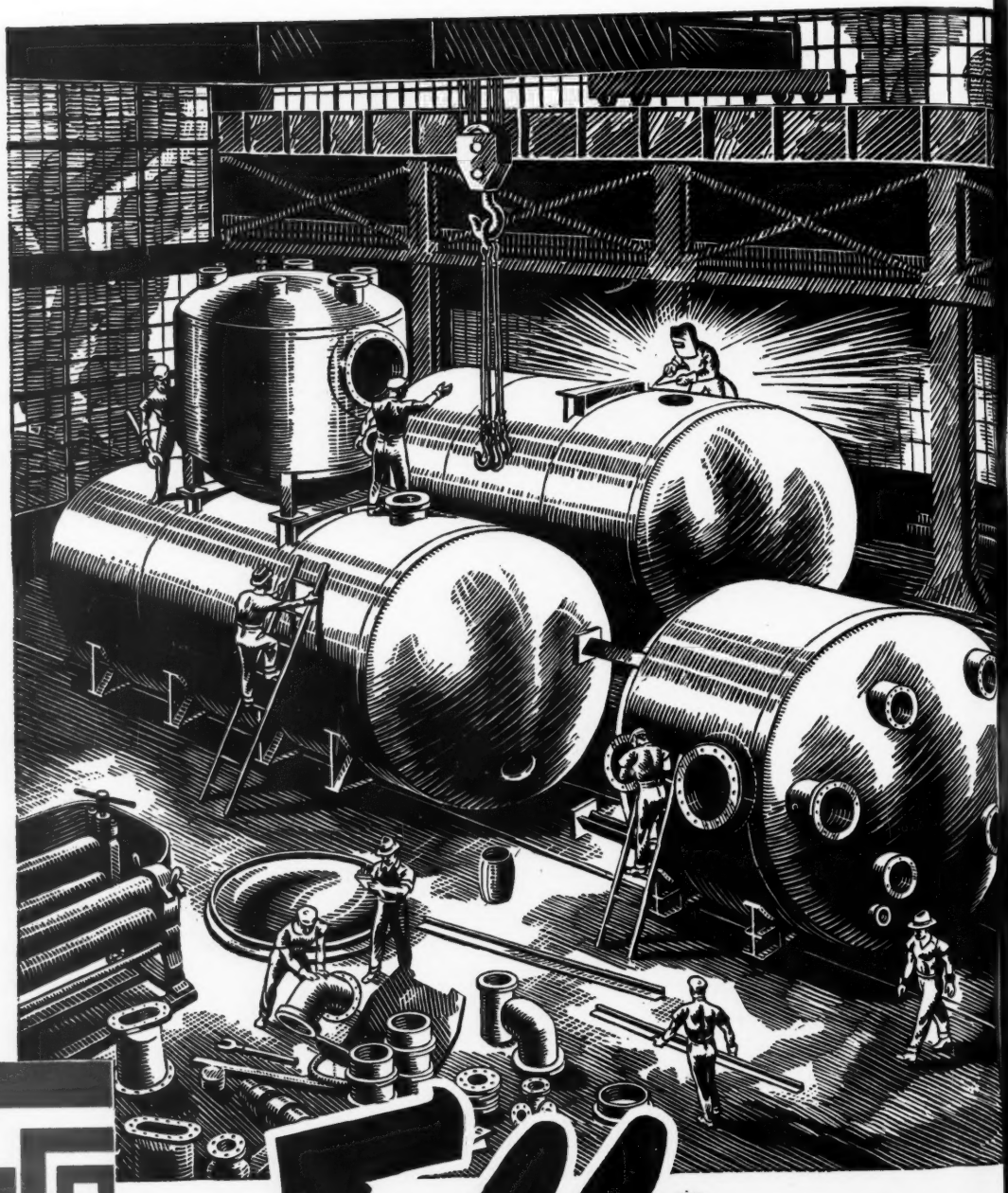
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

AUGUST • 1946

Features

EFFICIENT AND ECONOMICAL PIPING • MOTORIZED CONTROL VALVES • INTERCOMMUNICATION SYSTEMS • COAL HANDLING CONTROL • TESTING GREASES • CHEMICAL CLEANING • HOW TO CONTROL MARINE GROWTHS • ATOMICS • CONTENTS PAGE 5

The big



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ones are back

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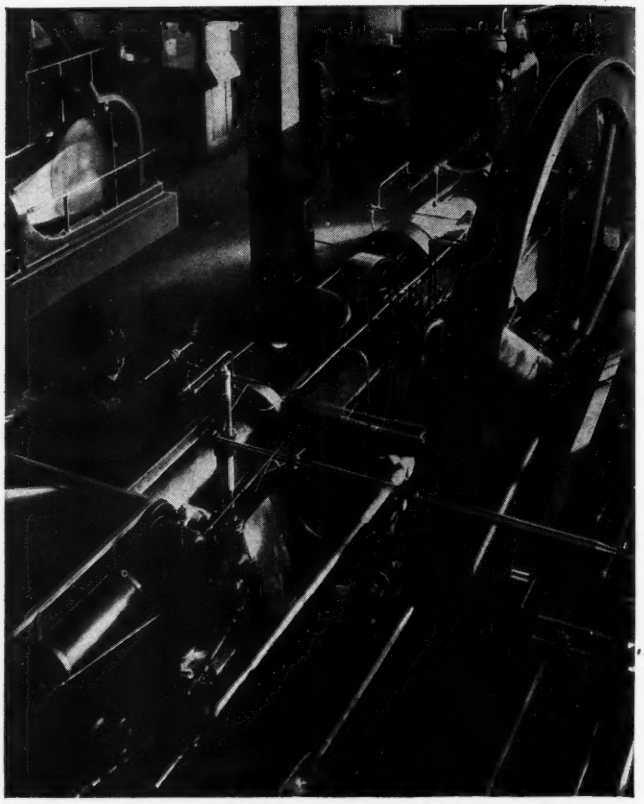
DEAERATING HEATERS



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Power Plant ENGINEERING

August, 1946

VOLUME 50—NUMBER 8

Cover: Typical of widespread use of power in candy industry is this chocolate enrobing machine driven by 3-hp splash-proof type motor. Steam at 30 lb, delivered through regulating valve at lower right, keeps melted chocolate at proper flowing consistency. Two pyrometers in front show chocolate temperature. Photo, E. J. Brach & Sons, Chicago.

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Jenkins PRACTICAL PIPING LAYOUTS 13

How to plan a HOT WATER RADIANT HEATING SYSTEM

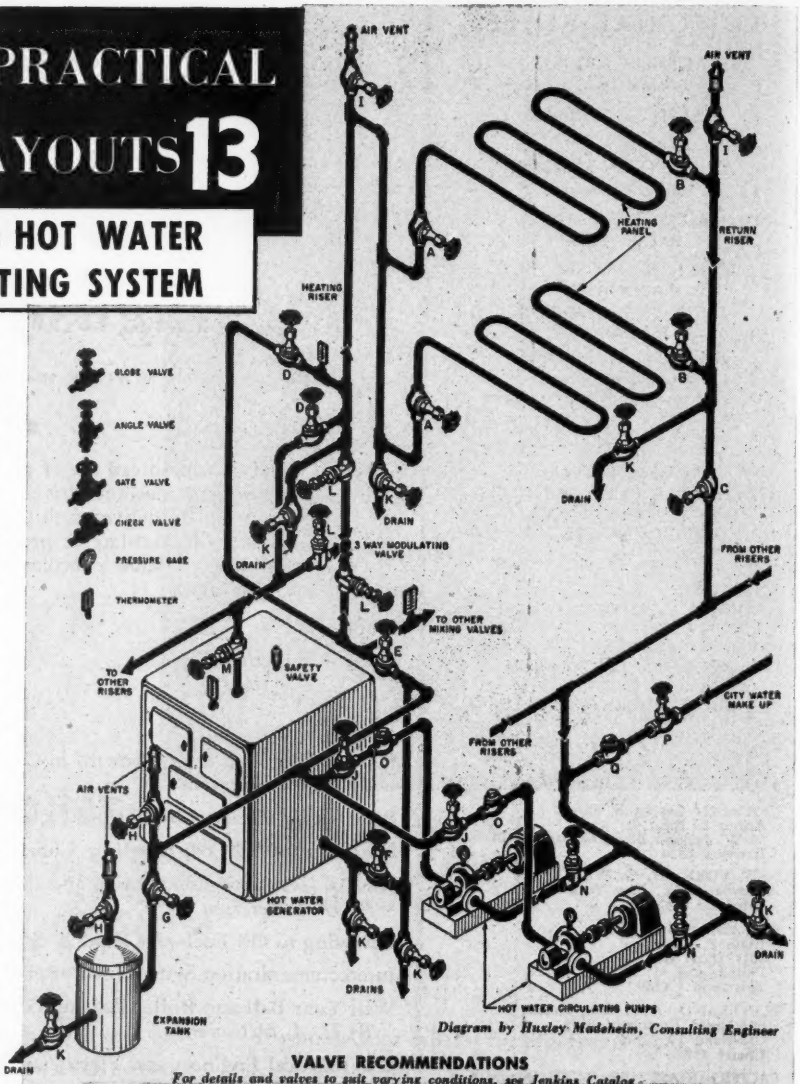

Diagram by Huxley-Madeheim, Consulting Engineer

Radiant heating, although it is as old in principle as the sun, is comparatively new to industry. It's use has increased rapidly in the past few years, however, because of its high operating efficiency, and because it saves valuable floor and wall space in institutions, office buildings, hospitals, and garages.

Concealed in walls, floors or ceilings, where it is inaccessible, it is obvious that the piping, and other equipment as well, must be carefully chosen to render long-life and trouble free-service. Thus, expensive charges for repairs and alterations – the usual objection to radiant heating – can be eliminated, or reduced to a cost comparable to maintenance of other types of heating systems.

Hot water is used in this typical low pressure, low temperature copper tube system, and is controlled by room and outdoor thermostats which in turn control 3-way mixing valves. Usually, one 3-way valve is installed for each main riser or zone under control of each thermostat. Drains are located at the heel of every riser and all low points to drain the system whenever necessary.

Other types and pressure ranges of Jenkins Valves can be used for this type of layout according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installations.

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Code	Quantity	Solder End	Screwed End	Service
A	1 per Panel	Fig. 1200 Br. Globe	Fig. 106-A	Panel Feed & Control
B	1 per Panel	Fig. 1200 Br. Globe	Fig. 106-A	Panel Return & Control
C	1 per Riser	Fig. 1200 Br. Globe	Fig. 106-A	Return Riser Shut-off & Control
D	2 per Riser	Fig. 1200 Br. Globe	Fig. 106-A	Feed Riser 3-Way By-Pass
E	1	Fig. 1200 Br. Globe	Fig. 106-A	Return to 3-Way Valve Control
F	1	Fig. 1200 Br. Globe	Fig. 106-A	Return to Heater Control
G	1	Fig. 1200 Br. Globe	Fig. 106-A	Expansion Tank Shut-off
H	2	Fig. 1200 Br. Globe	Fig. 106-A	Manual Air Vents
I	1 per Riser	Fig. 1200 Br. Globe	Fig. 106-A	Auto. Air Vent Shut-off
J	2	Fig. 1200 Br. Globe	Fig. 106-A	Pump Discharge Control
K	7	Fig. 1200 Br. Globe	Fig. 106-A	Drain Valves
L	3 per Riser	Fig. 1240 Br. Gate	Fig. 370	3-Way Valve Shut-off
M	1	Fig. 1240 Br. Gate	Fig. 370	Heater Feeder Main Shut-off
N	2	Fig. 1240 Br. Gate	Fig. 370	Pump Suction Shut-off
O	2	Fig. 1222 Br. Check	Fig. 92	Pump Discharge Checks
P	1	Fig. 106-A Br. Globe		Water Make-up
Q	1	Fig. 117-A Br. Check		Water Make-up

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Front Lines

IN THE FLEET of ships forming the atomic bomb test target at Bikini was the famous captured Nazi cruiser *Prinz Eugen*. The German engineers and shipbuilders put everything they had into making this ship a masterpiece of naval architecture, with firepower to shoot it out with the best of contemporary cruisers, and sufficient horsepower to run away from the fastest battleships. Contrary to what many engineers have been told, the *Prinz Eugen* was powered by geared steam turbines, driving three screws not four, as had been reported. Also, says H. Oman in Allis-Chalmers Electrical Review, engineers inspecting the ship failed to find any evidence that Diesel engines were used to drive the ship at cruising speeds. Steam for the propulsion turbines was generated in 12 high-pressure water tube boilers at 1020 psi and maximum steam temperature of 880 F. An interesting dog clutch, operated by air at 440 psi, was found, which automatically disengages the turbine from the propeller if the turbine develops trouble. The clutch could be engaged at any speed up to 15 knots and disengaged at any speed. The torque was transmitted through nests of springs and a mechanical syncroscope was provided. The ship was reported to have 80,000 shaft horsepower and a maximum speed of 33 knots with 290 rmp on the screws, while with one screw at 259 rpm she could make 22 knots. Most of the auxiliaries were 230-v, d-c generators, driven by steam turbines, except for two Diesel-driven generators. The provisions for instrumentation and control of all equipment from a number of points were extremely elaborate—too elaborate, in the opinion of many American engineers. The ship could be steered from 8 different points, all electrical panels had diagrams on them, everything was carefully labeled and many of the controls and operating devices were in duplicate. At this writing the only comment we have seen on the fate of the ship in the atomic test on Bikini was that she appeared unharmed. But until we hear from our own "Andy" Kramer on the spot, we won't form any case-hardened opinions.

ONLY A SMALL MINORITY of employers are relaxed and self-assured enough about the foreman problem to permit a detached airing of it. Most employers either shun the idea of getting their foremen's frank opinion (the "let-sleeping-dogs-lie" theory), or fail to get close enough to their foremen to stimulate an uninhibited flow of foremen opinions. This is one of the major findings of a survey of foremen's views just completed by the National Foremen's Institute. Summarized by A. C. Croft, President of the Institute, the survey covers the reactions of more than 1,000 foremen employed in the major manufacturing industries, trades and services, and public utilities.

THE ARMY-NAVY numbering system for anti-friction bearings was developed during the war with the assistance of men in the bearing industry. This work resulted in a system that makes it possible to code descriptively practically all standard ball and roller bearings, and was of great assistance to the Navy in eliminating some of the confusion caused by use of other numbering systems by various manufacturers. Now at a conference of the entire industry recently held under the auspices of American Standards Association, the various agencies and industries concerned have unanimously recommended that the ASA should set up an American Standard numbering system for ball and roller bearings. It is expected that the matter will be taken up by the Standards Council at an early date.

WE HAVE BEEN much entertained recently by the good-humored but well-pointed comments of George Kerr of Ebasco Services Inc. in our contemporary, *Electric Light & Power*, on the "high-hat" attitude of the electric power utilities in talking so much about "electric service." Mr. Kerr maintains that this is absurd because what the electric companies sell is not service but electricity. Mr. Kerr points out that the hardware merchant does not claim he is selling you "monkey wrench service," but merely a monkey wrench. The butcher doesn't sell you "steak service" but steak. Neither does the milkman send you a bill for "milk service." Mr. Kerr maintains that the attempt of electric utilities to make the sale of electricity seem more important than it is—for example, the practice of making customers "apply" for the "privilege" of buying "electric service" — is poor business psychology. He says such things complicate all the business relations of the utility with the customer, make it harder for the utility to sell its products—just plain electricity.

ONE OF THE MOST important recent advances in the field of magnetic testing has been the development of the Du Mont Cyclograph for non-destructive testing of metal. The apparatus makes use of the fact that a correlation exists between physical properties and electrical and magnetic properties of metal. To compare them, the parts to be tested are made the core of a test coil, the characteristics of which are governed by the core properties. These influence the operation of an oscillator and the operation finally results in a pattern on a cathode-ray tube indicator screen. The cyclograph tests do not supplant standard physical and metallurgical tests, but are used primarily in production line work to compare parts against known standards and reveal those which do not conform; the latter can then be given standard tests.

HOW CAN YOU put a trademark on coal? Well, there is a possibility that it can be done by using a certain radio-active material applied through water or oil sprays by the coal producer. This may make it possible to identify the source of the coal. It could not be identified, of course, by visual inspection, but by using a Geiger counter on a small sample of ash from the coal. The object of the new method is to give producer, dealer and consumer alike a means of checking the source. The process is being studied and developed by Arthur D. Little & Company, Inc.

A BIBLIOGRAPHY on the heat pump as a device for domestic and industrial winter heating and summer cooling has been issued by Southern Research Institute. A survey just completed under the direction of E. N. Kemler, Head of the Engineering Research Division, discloses that several equipment manufacturers are actively engaged in heat pump development work and that prospects are good for the installation of several thousand units during the year.

USE OF CARBON FILTERS for scrubbing air and removing odors and vapors in air conditioning systems is a development that will be used in many of the new railroad coaches and Pullmans to be equipped with air conditioning equipment. It saves the space that is so precious on train air conditioning systems and permits the same air conditioning apparatus to give the equivalent of a 75 per cent air renewal.

OPERATION of the Hanford Works of the Manhattan District has recently been transferred from E. I. duPont deNemours & Co. to General Electric Co. The duPont organization had requested the War Department to permit it to retire from the Hanford Plant as soon after the end of the war as possible and General Electric assumed the responsibility of carrying on the project at the request of Major General Leslie R. Groves, Chief of the Army's atomic project. The transfer will become effective on September 1, 1946. General Electric Co. plans to explore the peacetime possibilities of atomic energy as a source of power as well as its military applications.

IMPROVEMENTS and changes in the techniques of printing have come rather slowly in recent years, although a great many new and revolutionary ideas have been advocated. Some investigation is now under way, for example, on methods of printing by drawing ink from type to paper by an electrical process without pressing the paper and type together. Another recently announced invention, by E. C. V. Oldofredi, aims to replace expensive cuts with dies made from wire mesh fabric, light in weight and low in cost, to reproduce designs or lettering. A wire-mesh cloth of monel wire is used and the master cut is impressed on the wire mesh by a simple hand press. The dies, it is claimed, can then be easily adapted to ordinary cylinder or flat bed presses.

A SECRETARY is a person, usually female, whom the boss often tells everybody but her that he couldn't do without.

A secretary must know how to translate the boss's rambling dictation into statements which are crisp and straightforward and yet have plenty of loopholes and side exits, so that he is pretty proud of himself when he reads what he thinks he dictated.

If the boss doesn't know something, he asks his secretary; if she doesn't know, she is dumb. The boss is not dumb for not knowing, on account of what has he got a secretary for?

No man is a hero to his valet, and no boss is a hero to his secretary. When a secretary realizes that her boss wouldn't be worth fifteen dollars a week without her, she has to console herself with the fact that she wouldn't get her thirty-five per without him.

If secretaries didn't need their jobs, half the bosses in the country would be washed up. If secretaries published their bosses' confidential memos, the other half would be locked up.

A secretary must know where her boss is every minute, so she can tell the right people the wrong place.

An office boy starts at the bottom and works up. A secretary starts as secretary and works.—The Hydromike.

USE OF CERAMIC and sintered materials in the production of high-heat-resisting turbine blades is one of many noteworthy developments in the German electrical and technical ceramic industry described in a report released by the Office of the Publication Board, Department of Commerce (PB-18776; photostat, $10; microfilm, $1.50; 144 pages, including diagrams.) The Germans have also made wide use of porcelain insulators for general utility work, in contrast to American use of glass and plastics, according to the report.

A MINIATURE OCEAN in which ships' gear remains stationary while water is forced past it, is helping the U. S. Navy uncover new secrets of design to improve performance of its fighting ships. Called a circulating water channel, the latest test unit of the David W. Taylor Model Basin, Washington, D. C., sends 750,000 gal of water coursing through an upright circular aqueduct and drives it against ships' gear or scaled ship models in a reverse simulation of real equipment plowing its way through the ocean. Two Westinghouse 1000-hp motors furnish the power to circulate 2,800 tons of water in the channel at speeds as high as 12 mph. Surface water is kept flat to permit visibility of under-currents, and naval engineers can watch turbulence from beneath or from either side through plate glass. Through the glass, the water's push against objects can be photographed, either with still camera or a movie camera. To get different rates of speed of the water in the test channel, the huge impeller pumps were fitted with variable-pitch blades. No effort has been spared to keep the water in the channel clear so that photographic records of tests may be complete.

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THE SIZE OF A TURBINE has nothing to do with how hard it is on lubricating oil. Unit bearing pressure . . . maximum bearing temperature . . . times-per-hour oil is circulated . . . lube system "tightness" . . . these are the real considerations, and they almost always show that the industrial steam turbine is really "tough" on oil by comparison with its huge central-station brother.

With high stability toward oxidation and with positive rust-preventive properties, Shell Turbo Oils solve particularly tough problems in steel mills, mines, paper mills and processing plants. *In central stations,* Shell Turbo Oils are establishing service records unbelievable a few years ago.

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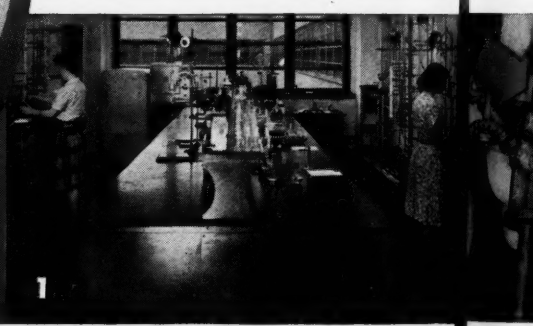

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EASTERN REGIONAL RESEARCH LABORATORY USES HUNDREDS OF YARWAY IMPULSE STEAM TRAPS ON PILOT PLANT EQUIPMENT

Yes, actually hundreds of Yarways are on the job in this great modern laboratory of the United States Department of Agriculture at Wyndmoor, Pa.

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Here, also, as in processing plants from coast to coast, Yarway Impulse Steam Traps prove their worth. These "mighty mites" help get the many pieces of processing equipment hotter, sooner . . . *and keep them hot.*

Yarway's *small size* saves valuable space . . . their *light weight* simplifies installation. Maintenance is reduced because they have only *one moving part*—a simple valve. Also important, Yarway Traps are *suitable for all pressures without change of valve or seat.*

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Yarway Impulse Steam Traps are now made and sold in Canada and Great Britain

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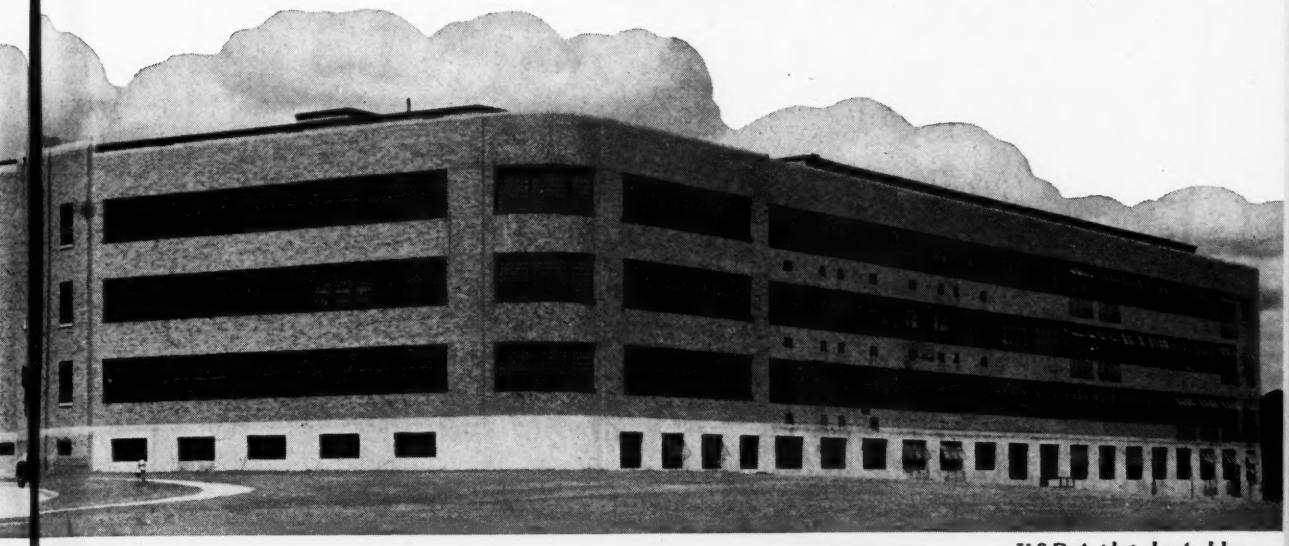
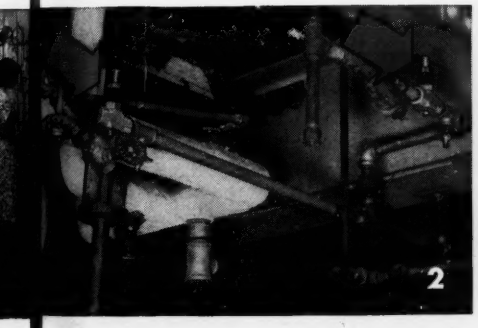
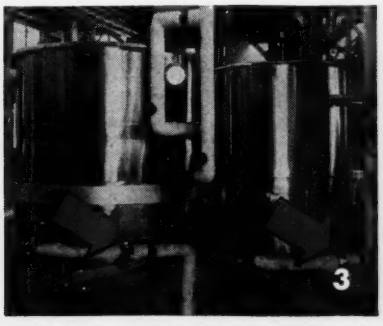
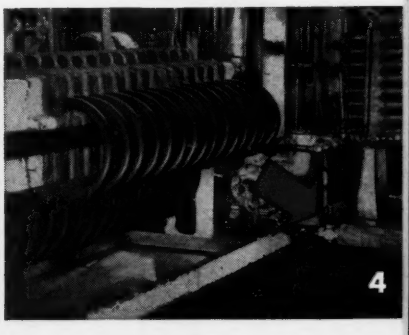


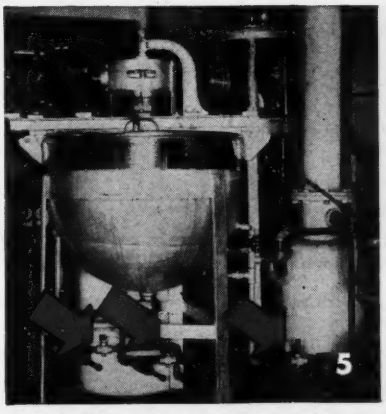
U.S.D.A. photo by Audsley

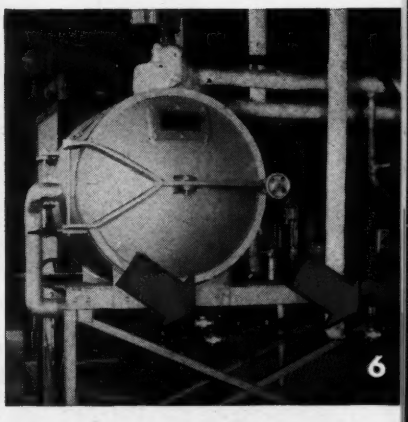






1. Organic Research Unit at the Eastern Regional Research Laboratory.
2. Overhead arrangement of two Yarway Impulse Steam Traps handling condensate from experimental equipment on floor above.
3. Yarway Traps on two steam jacketed stainless steel tanks.
4. Yarway Trap on condensate line from steam jacketed filter press.
5. Three Yarway Traps on agitated steam jacketed kettle.
6. Three Yarway Traps on steam-heated vacuum drum dryer.





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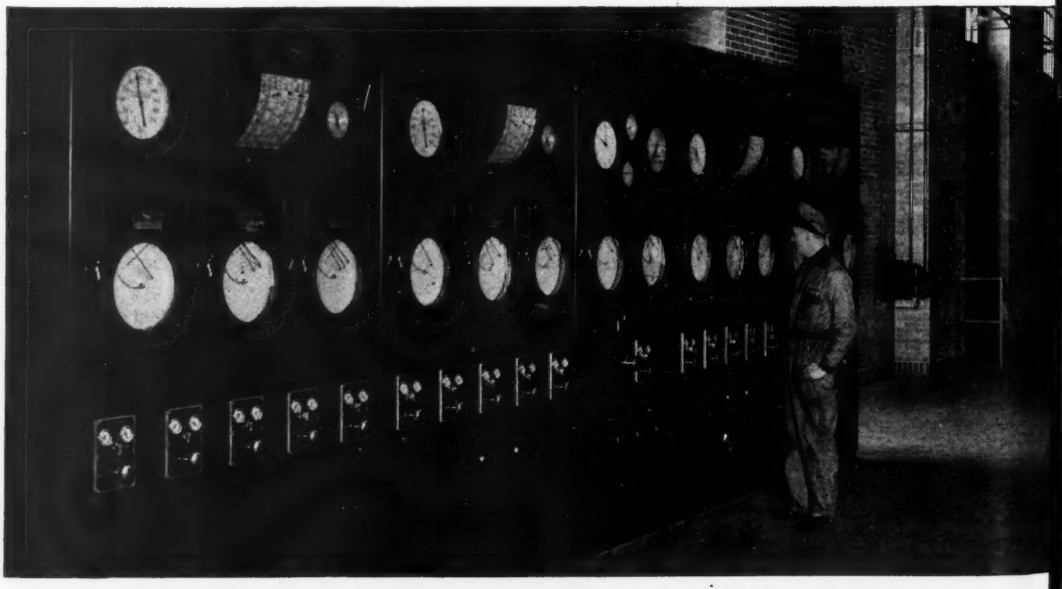
1. Continuity of service.
2. Evaporation ratio.
3. Safety of operation.
4. Peak steaming capacity.
5. Utilization of available manpower.



This Bailey Boiler Control Panel continuously maintains Optimum Performance in a central heating plant.

BAILEY METER CONTROL

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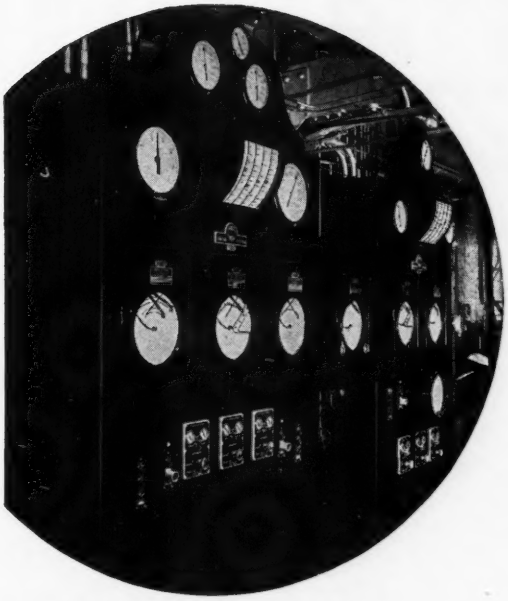
★ Optimum performance may be secured on all these counts by applying engineered instrumentation in the form of Bailey Boiler Meters and Control.

Bailey Boiler Meters and Control are specified and applied to the individual requirements of each plant. Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation, and final adjustment on the job.

Engineering work in the user's plant is done by Bailey Field Engineers, who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has a background of combustion engineering "know-how" which has been accumulated through years of service. He has at his command the results of thousands of tests on boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant. G-24



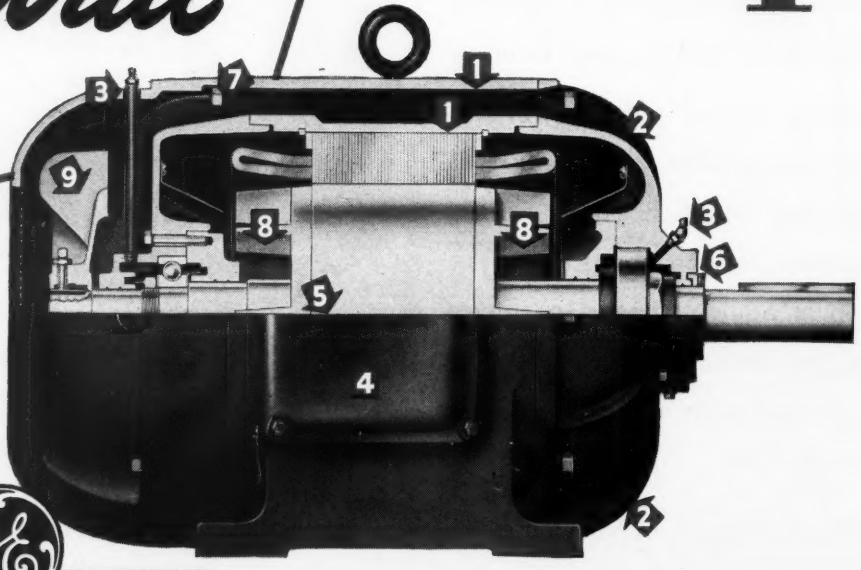
Installation of Bailey Boiler Meters and Boiler Control in an Eastern paper mill. This equipment automatically functions to maintain daily boiler performance at the same high standards obtained during boiler tests.

BAILEY METER COMPANY
1040 IVANHOE ROAD, CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

A Double Wall Keeps



TRI/CLAD

TOTALLY ENCLOSED STANDARD and EXPLOSION-PROOF MOTORS

These 9 points of new strength and serviceability put this TRI/CLAD totally enclosed motor way ahead.

1. A cast-iron, double-wall frame that completely encloses windings and punchings
2. Ribbed, cast-iron end shields, machined to provide a tight seal, yet easily removed
3. Well-proved, pressure-relief greasing system which can be packed with a long-life lubricant where advisable
4. Cast-iron conduit box diagonally split for wiring convenience (independently explosion-proof on explosion-proof motors)
5. Leads are sealed in a nonshrinking compound at the point where they emerge from the frame
6. Rotating labyrinth seal prevents infiltration of grit or liquids
7. Large, free-flowing, easy-to-clean air passages protect parts from accumulation of dust and foreign material
8. Modern "ageless" insulation treatment includes Formex* magnet wire
9. Powerful external fan is removable, simplifying maintenance (nonsparking type for explosion-proof motors)

AND IN ADDITION—compactness and short length promote ease of handling and installation

*Trade-mark reg. U.S. Pat. Off.

FOR THE COMPLETE STORY

Apparatus Department
General Electric Company
Schenectady 5, N. Y.

Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motor.

Please send me GEA-4131, "Motors and Control for Hazardous Locations."

Name.....

Company.....

Address.....

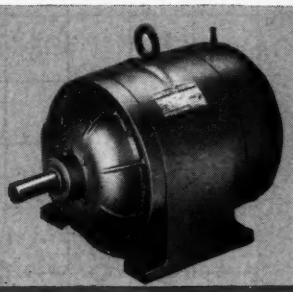
750-257-8030

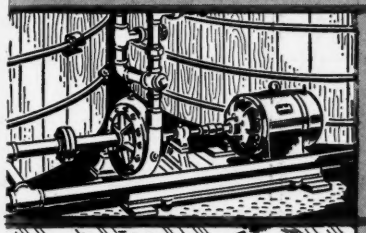
GENERAL ELECTRIC

Trouble Out

NEW TRI/CLAD TOTALLY ENCLOSED MOTOR IS MORE FULLY PROTECTED FROM DUST, DIRT, WEATHER, OR WHAT HAVE YOU...

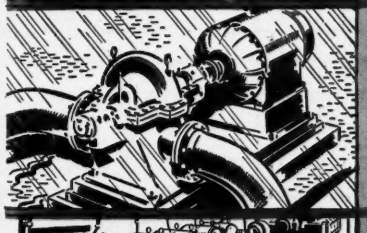
Now, General Electric has applied Tri-Clad construction to its line of totally enclosed induction motors (1 to 1000 hp) and to most of its explosion-proof motors as well. *Extra protection* has been raised another notch.





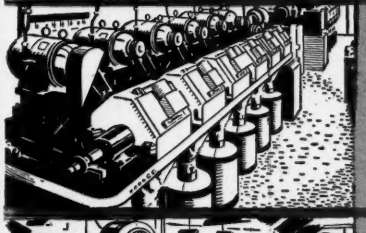
FOR EXTRA-SEVERE JOBS

Applications amid dust, metal filings, coolants, or corrosive agents—where totally enclosed motors have always been required—will now have the benefit of a stronger armor, plus convenience features that simplify installation and servicing.



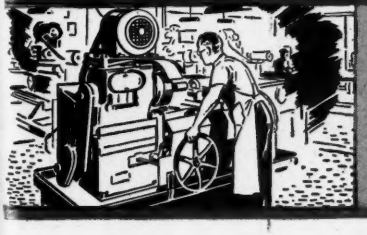
FOR EXTRA-WET LOCATIONS

Indoors or out, these Tri-Clad totally enclosed motors will take hosings or heavy rains without danger of shutdown. The cast-iron frame is strongly resistant to rust and corrosion.



FOR HAZARDOUS ATMOSPHERES

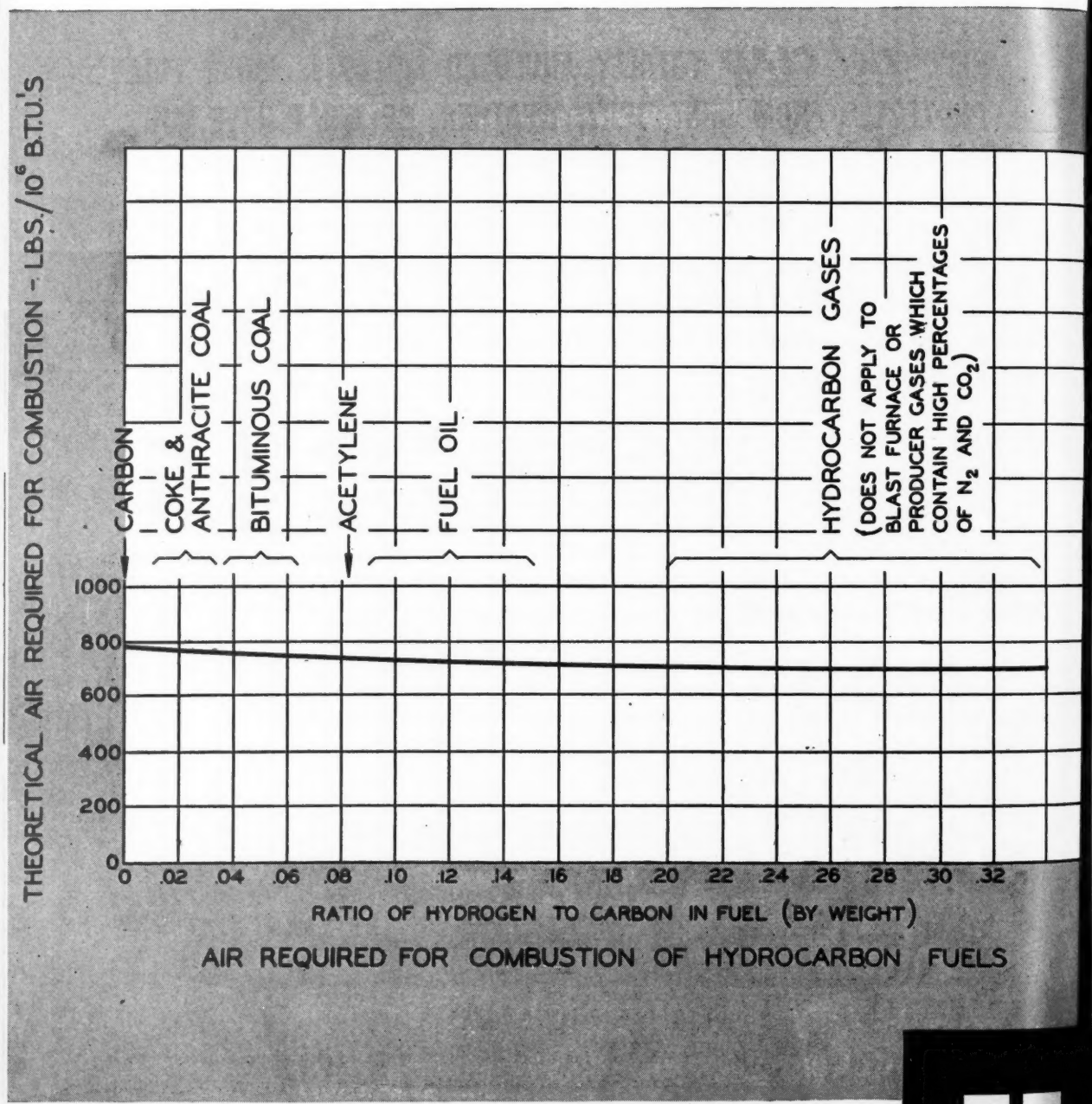
"Companion motors" to the standard Tri-Clad totally enclosed, the new explosion-proof and dust-explosion-proof types are tested and listed by Underwriters' Laboratories for Class I, Groups C and D, and Class II, Groups E, F, and G.



FOR EXTRA-LONG LIFE

Many motor users are making the totally enclosed motor their standard for *all* jobs—based on evidence of long-term savings. This new member of the Tri-Clad line makes this decision more logical than ever.

3 fuels


THEORETICAL AIR REQUIRED FOR COMBUSTION - LBS./10⁶ B.T.U.'S
CARBON
COKE & ANTHRACITE COAL
BITUMINOUS COAL
ACETYLENE
FUEL OIL
HYDROCARBON GASES
(DOES NOT APPLY TO BLAST FURNACE OR PRODUCER GASES WHICH CONTAIN HIGH PERCENTAGES OF N_2 AND CO_2)
1000
800
600
400
200
0
0 .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22 .24 .26 .28 .30 .32
RATIO OF HYDROGEN TO CARBON IN FUEL (BY WEIGHT)
AIR REQUIRED FOR COMBUSTION OF HYDROCARBON FUELS

Relation between heat value of fuel and air requirements. Note how closely a measurement of heat released within a boiler furnace indicates the amount of air required for combustion, not only for any single fuel but even for fuels of widely differing physical characteristics.

HAGAN
HALL
BUROMIN
CALGON

IN VARYING COMBINATIONS

but excess air is correctly maintained

by the HAGAN DIFFERENTIAL MASTER SYSTEM

A large refinery burns refinery gas, oil and mercaptan gas, sometimes singly, sometimes two, or all three at the same time.

B.t.u. content of the oil is relatively uniform; refinery gas varies both in B.t.u. content and density.

Yet—by the Hagan Differential Master method of automatic combustion control, *excess air is correctly controlled* in spite of all fuel changes.

B.t.u. input is automatically adjusted to load demand by the usual Steam Header Master Sender. The Differential Master Sender utilizes the boiler itself as a calorimeter of heat input to control air flow. In this installation, *the heat input of all fuels in use at any instant is automatically totalized by the boiler itself, and the air flow is controlled accordingly.* Control is positive and direct; there is no lagging corrector system.

Automatic control by other methods requires extensive and complicated apparatus, and is commercially impracticable because of cost and operating difficulties.

The Hagan Differential Master method has been thoroughly tested in service. It has been applied to boilers burning oil, gas, pulverized coal and multiple fuels. Boiler sizes range from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1,800 p.s.i. *Every installation* has been entirely satisfactory.

Our engineers will be glad to give you full information.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

IRON FIREMAN

is more than a word

HERE ARE THE REASONS:

In the Combustion Zone

No part of the Iron Fireman Pneumatic Spreader stoker is subject to the direct heat of the combustion chamber. What this means in terms of low maintenance costs can be readily appreciated by any combustion engineer.

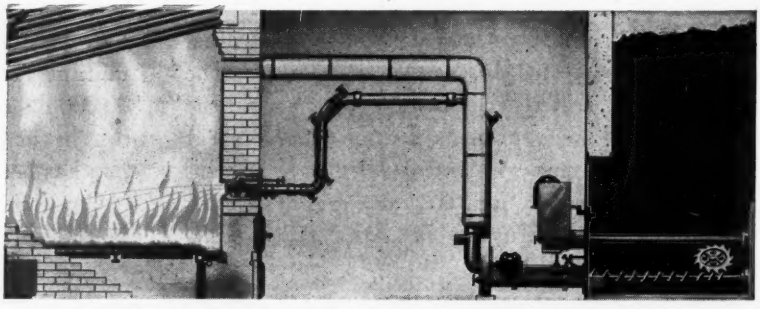
As can be seen in the accompanying sketch, the only stoker part inside the furnace above the grate line is the coal nozzle, which is constantly surrounded by currents of cooling air admitted through an adjustable vent.

The pneumatic spreader grates themselves, which are an exclusive Iron Fireman feature, are likewise fully protected. Integral cooling fins on stationary grate sections conduct heat away from the upper surfaces. Dumping grates are so designed that a protective ash coating remains on the top surface, even when sections are in a dumping position. This feature, together with the cooling fins on the under side of the grates, protects them from excessive heat. An ingenious arrangement of lateral air ports, in conjunction with the residual ash on the upper grate surface, diffuses the air over the entire grate surface, giving higher combustion efficiency.

In the Conveyor Zone

All moving parts connected with feeding and conveying of coal are located near the coal supply, entirely separate from the boiler and unaffected by furnace heat. The conveyor system is very simple in operation. It includes motors, power transmission, coal pick-up and transfer mechanism, and conveyor fans. These parts are readily accessible for easy inspection and maintenance. A further reason for Iron Fireman dependability is the ample margin of strength built into all Iron Fireman equipment.

That Iron Fireman's careful engineering pays out in practice is proved by records of thousands of installations in which low fuel costs are combined with exceptionally low maintenance and thorough dependability.

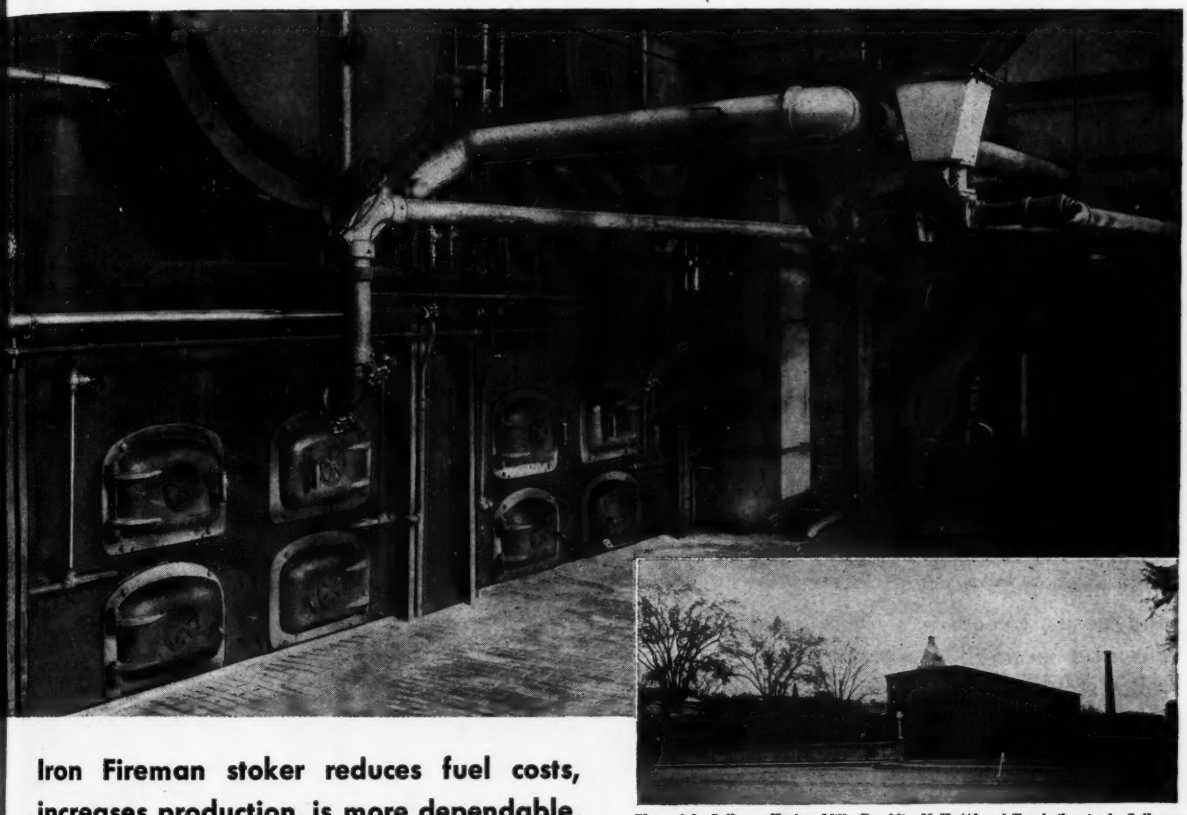


THE IRON FIREMAN PNEUMATIC SPREADER STOKER meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

Heavy Duty Automatic Coal Stoker for Power Processing and Heating

DEPENDABILITY

it is a *FACT*



Plant of the Sulloway Hosiery Mills, Franklin, N. H. (Above) Two boilers in the Sulloway plant fired by Iron Fireman Pneumatic Spreader stokers.

Iron Fireman stoker reduces fuel costs, increases production, is more dependable, says Sulloway Hosiery Mills, Franklin, N. H.

When the Sulloway Hosiery Mills depended upon hand firing methods it was extremely difficult to carry the peak loads, according to Chief Engineer Edmund J. Garneau. After installation of Iron Fireman Pneumatic Spreader stokers under the same boilers, the company was able to add three processing machines, increasing the load as much as 42% at peak periods. This was accomplished with but very slight increase in coal consumption. In addition to increased production and lowered fuel costs, Mr. Garneau states that elimination of supervision in the boiler room and Iron Fireman's overall dependable performance have been highly gratifying.

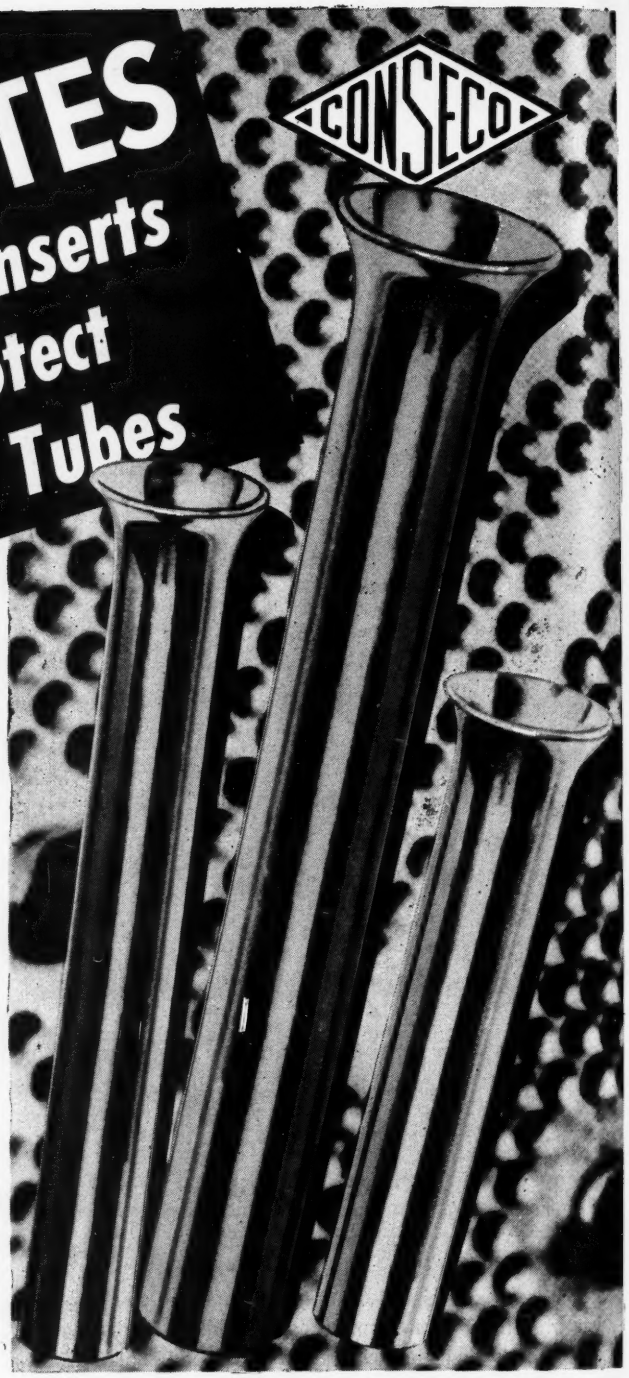
What about YOUR boiler room?

Are you sure your steam and labor costs are as low as they should be? Without cost or obligation you can have an accurate, impartial survey of your boiler room. Write to Iron Fireman Manufacturing Company, 3051 West 106th Street, Cleveland 11, Ohio. Plants at Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers throughout the United States and Canada.

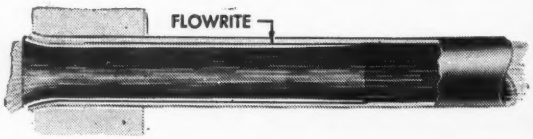
IRON FIREMAN

Only FLOWRITES METAL Tube Inserts Really Protect Condenser Tubes

CONSECO



Only METAL can absorb the erosive as well as the corrosive action inside condenser tubes. For 24 years, millions of Flowrites in thousands of installations have proved this. Made of the same metal as the tubes, Flowrites are non-breakable, simple to install, and easily replaceable when worn. Yes, Flowrites eventually wear out, but your tubes stay in. They are made for all size tubes in lengths up to 26" to suit conditions. Write or phone for our new bulletin giving details and M.I.T. test data.

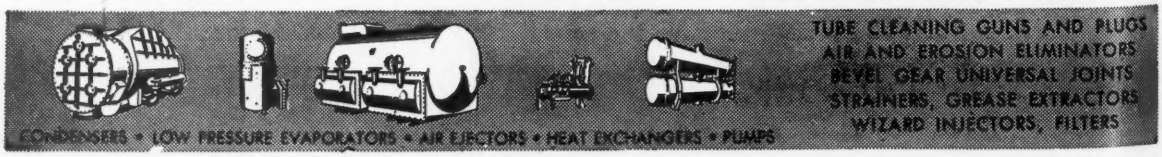


Flowrites may be used with any type tube joint. Tests at M.I.T., Boston, Mass., show venturi shape reduces water friction 80%.

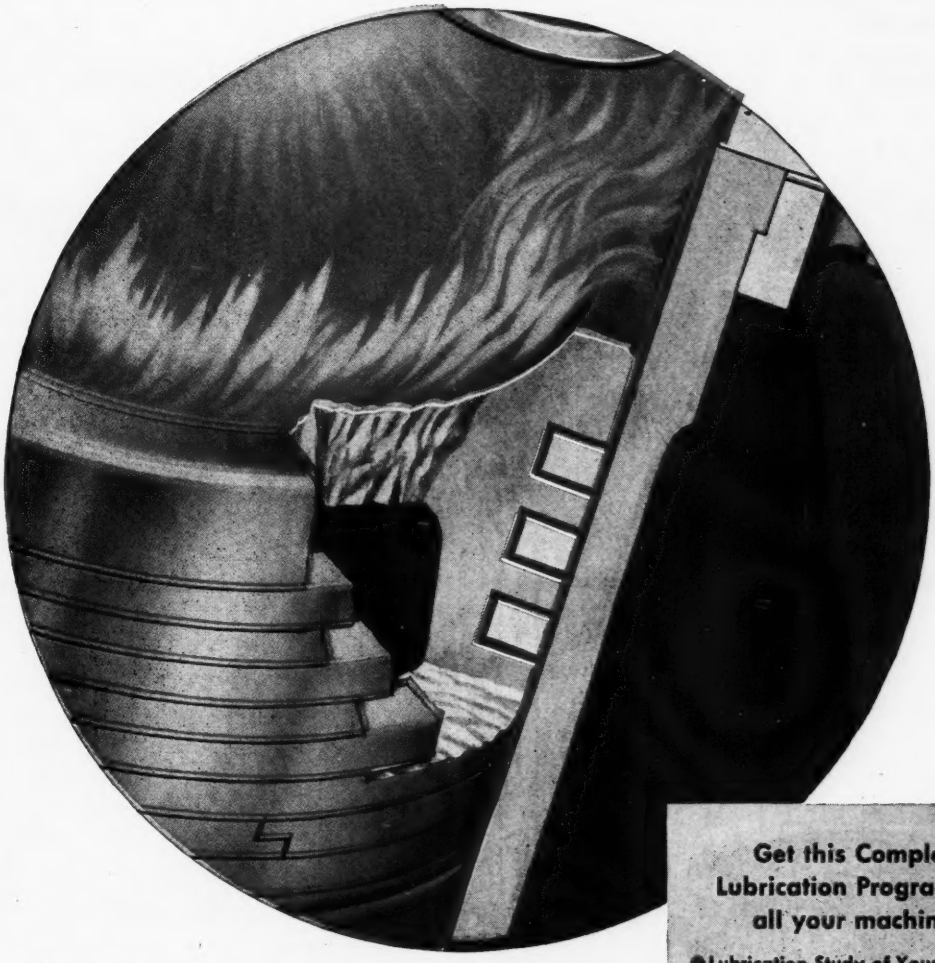
A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

CONDENSER SERVICE & ENGINEERING CO., INC.

69 RIVER ST., HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays - HOboken 3-4428**


TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS
CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

Oil's "on the spot" in this ring zone!



HERE, in this ring zone, your Diesel oil is really "on the spot."

When combustion temperatures soar and hot gases push down and behind the rings, the oil you use must stand both the heat and the pressure. Carbon deposits that cause ring sticking, blow-by and loss of power must be held to a minimum.

Since lubricating Dr. Diesel's first engine, Socony-Vacuum has kept pace with Diesel progress by continually improving oils to meet increased ring-zone temperatures and pressures. Today's superior Gargoyle D.T.E. Oils minimize deposits and blow-by, reduce wear—keep Diesels on the job longer with less maintenance time and costs.

Why not make certain of maximum Diesel efficiency now, with the best oils you can buy for the toughest Diesel service?

Get this Complete Lubrication Program for all your machines

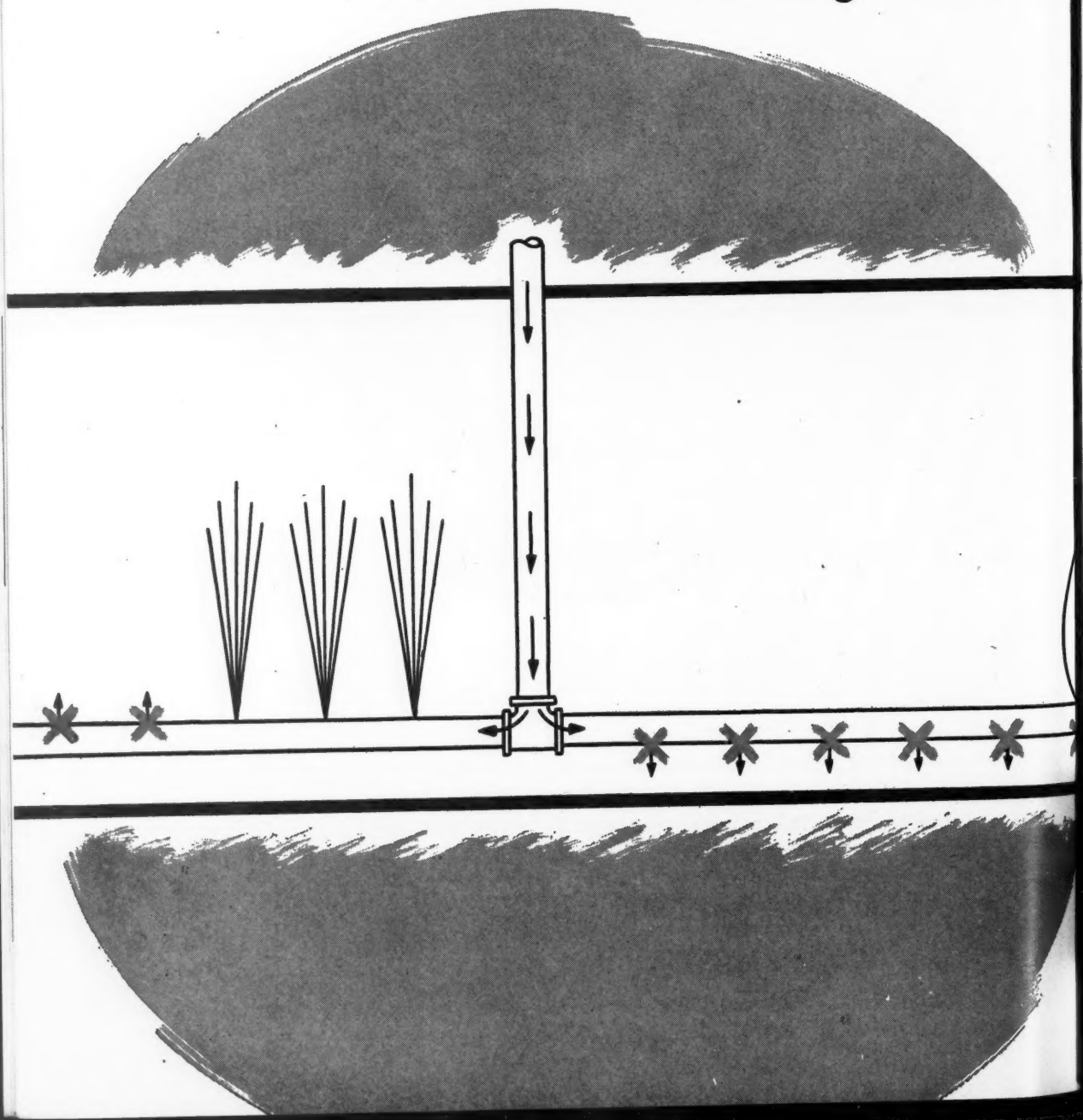
- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Co. · General Petroleum Corp. of Calif.

Boiler water conditions seemed satisfactory . . . but tube losses continued . . . until the **Hall Engineer** *went int*



Following trouble-free operation for a number of years, one boiler in an eastern refinery suffered losses of water wall tubes with exasperating regularity.

Analyses of deposits from the tubes showed some evidence of undertreatment with phosphate, but boiler water analyses showed normal conditions. This suggested the possibility of boiler water samples not being representative but an inspection of the boiler by the Hall engineer was necessary to determine *why*.

into the boiler

Examination of the feed water distributing system quickly revealed the source of the trouble. The arrangement was a common one—a pipe through the top of the steam drum to a tee below the water level, with a perforated branch line extending from each end of the tee.

In the right hand branch, facing in the direction of firing, the perforations were on the under side of the pipe—and every one was completely clogged. In the left hand branch the holes were on the upper side of the pipe, but of thirteen perforations, only the three nearest the tee were open.

Obviously, there was certain to be maldistribution of feed water and chemical, with consequent deficiency in treatment in certain sections of the boiler. Scale developed on tube surfaces, flaked off, and accumulated in the bends of the water wall tubes.

To correct the trouble it was only necessary to remove and clean the clogged pipes, which were then replaced with all perforations on the upper side.

On this job, the source of tube trouble was quickly removed because the Hall service engineer knew how to interpret the conditions indicated by the deposits and boiler water analyses.

"Trouble shooting" such as this is an important part of Hall service but of even greater importance is the prevention of trouble. Hall Laboratories have an outstanding record in both of these tasks.

Every plant that generates its own steam can profitably use Hall service. We will be glad to send you full information.

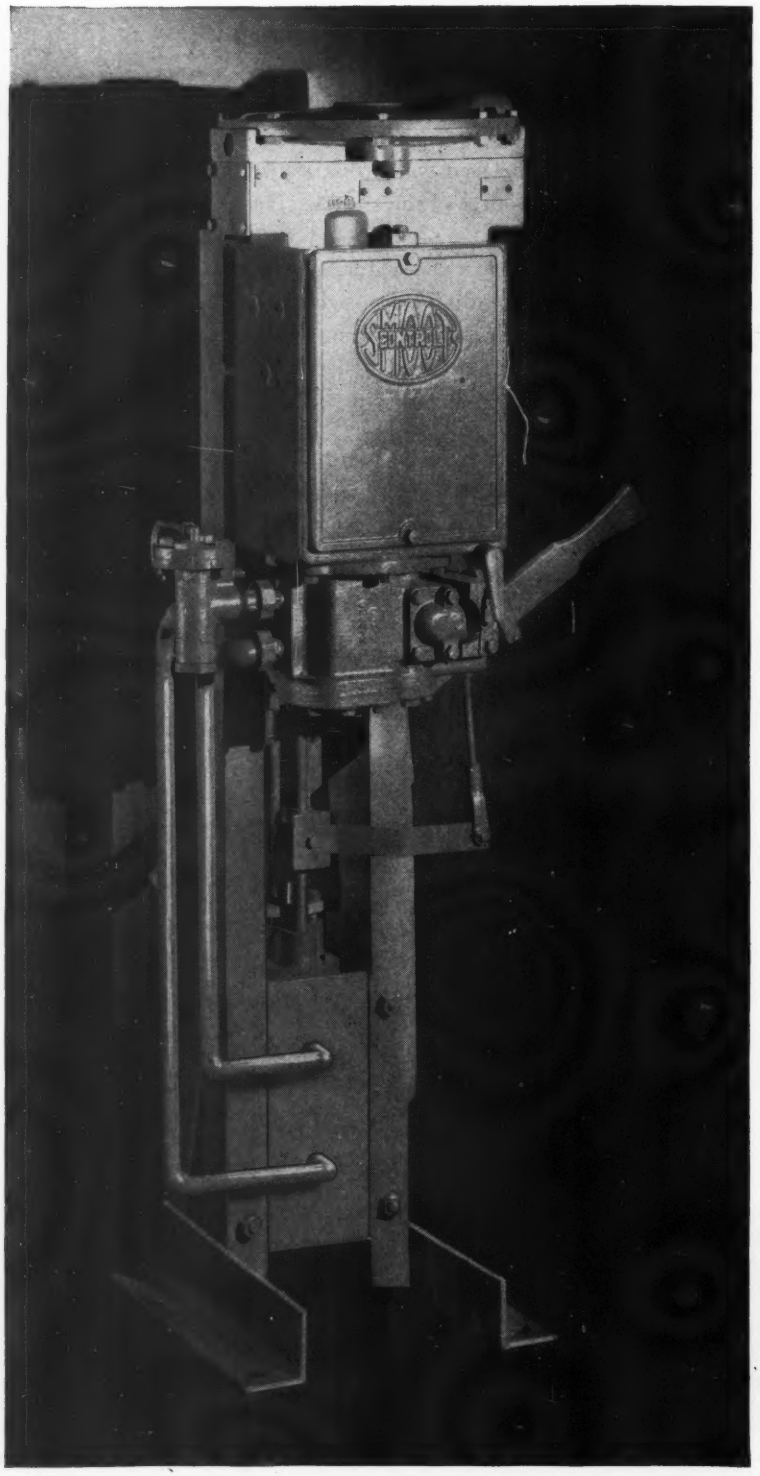
HALL LABORATORIES, INC. **HAGAN BUILDING** **PITTSBURGH 30, PA.**

(A Subsidiary of Hagan Corporation)

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM *of Boiler Water Conditioning*

The Trend is to...



REPUBLIC REGULATOR APPLICATIONS

Pressure Control

Steam pressure control
Boiler furnace draft
Primary air pressure
Feed water pressure
Evaporator pressure
Process steam pressure
Blast air pressure
Exhauster suction
Fuel gas pressure
Suction main pressure
Excess pressure

Flow Control

Water flow to desuperheaters
Water flow to condensers
Oil flow to boilers and furnaces
Gas flow to boilers and furnaces
Air flow to gas producers
Pump bypass

Level Control

Hot well levels
Surge tank levels
Storage tank levels
Evaporator levels
Boiler water levels

Speed Control

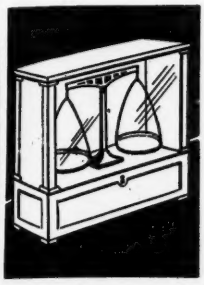
Stoker and fuel feeder speeds
Pulverizer speed
Pump speed
Fan speed
Steam turbine speed
Steam engine speed
Variable speed motors
Variable speed transmissions

View of a Republic hydraulic type regulator for controlling boiler air flow, mounted on stand with power cylinder.

REPUBLIC
INSTRUMENTS
AND CONTROLS

REPUBLIC Regulators

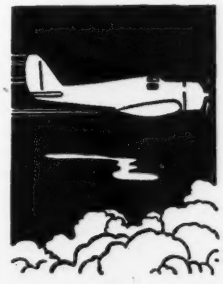
Because They Meet These Four Essentials of Good Regulation



Republic Regulators can be made sensitive to changes of less than 0.002 of an inch of water.

SENSITIVITY

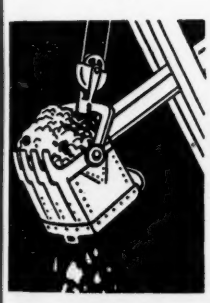
The amount of change that is required in the quantity being controlled to effect the regulator is the measure of its sensitivity. For close, accurate regulation, a regulator must be sensitive. It must respond immediately to the slightest deviation from the predetermined setting or the controlled quantity may vary far beyond the permissible limits.



Republic Regulators will meet any speed requirement up to one full stroke in 2 seconds.

SPEED

The speed at which a regulator operates is an important factor in any control system. Any time lag between the variations in the controlled quantity and the operation of the control device to correct this variation, will produce an unnecessary error in regulation. A regulator, therefore, must be fast enough to follow the fastest load fluctuation.



Republic power cylinders are available to meet the specific power requirements of any particular installation.

POWER

A regulator must have sufficient power to not only operate the valve or other control device, but also to overcome any accidental friction or sticking that may occur in any part of the system. Insufficient power will cause failure in operation. It is for this reason that regulators are made with different size power cylinders, the smaller sizes being used for small valves and the larger sizes for the larger dampers and louvers.

The Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

STABILITY

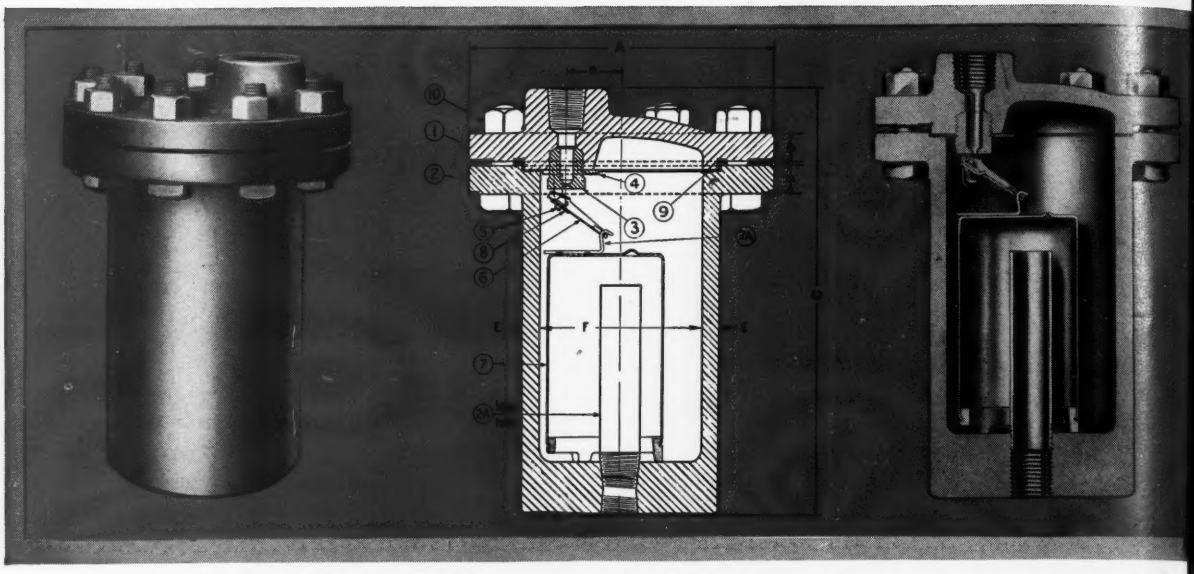
Stability refers to the ability of a regulator to maintain its balanced position or to return immediately to a balanced position if the controlled quantity is disturbed. There is always an interval between the time the valve or other control device is moved and the time the controlled quantity changes in response to this movement. Unless a regulator is stabilized it will tend to "hunt" or overtravel causing unnecessary variations.

Write for Data Book No. S-13

Republic Flow Meters Co.

2224 Diversey Parkway o **Chicago 47, Illinois**

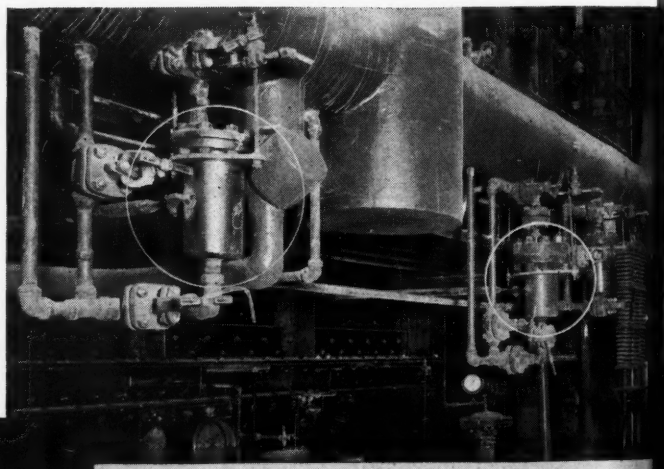
FORGED STEEL

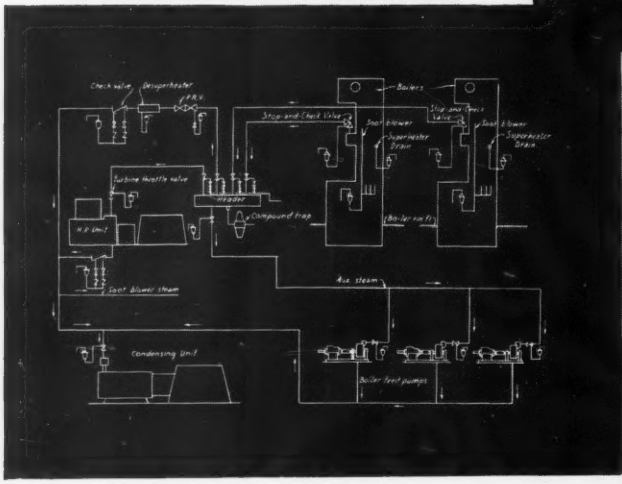


. . . with screwed connections

LIST OF MATERIAL
(Traps No. 312-515)

Part No.	Name of Part	Material
1 & 2	Cap and Body	Die Forgings (S.A.E. 1030) 79,000 lbs. Tensile Strength
2A	Inlet Tube	Wrought Iron
3	Valve Seat	Chrome Steel (Heat Treated)
4	Guide Pin Assembly	18-8 Stainless Steel
5	Valve	Chrome Steel (Heat Treated)
6	Lever	18-8 Stainless Steel
7	Bucket	18-8 Stainless Steel Cap & Tube—Cast Iron Bottom Weight
7A	Bucket Hook	18-8 Stainless Steel
8	Valve Retainer	18-8 Stainless Steel
9	Gasket	Compressed Graphited Asbestos
10	Bolt & Nut Set	Bolts Supertemp Steel, 149,000 lbs. Tensile, nuts hex. semi-finish (S.A.E. 1030)





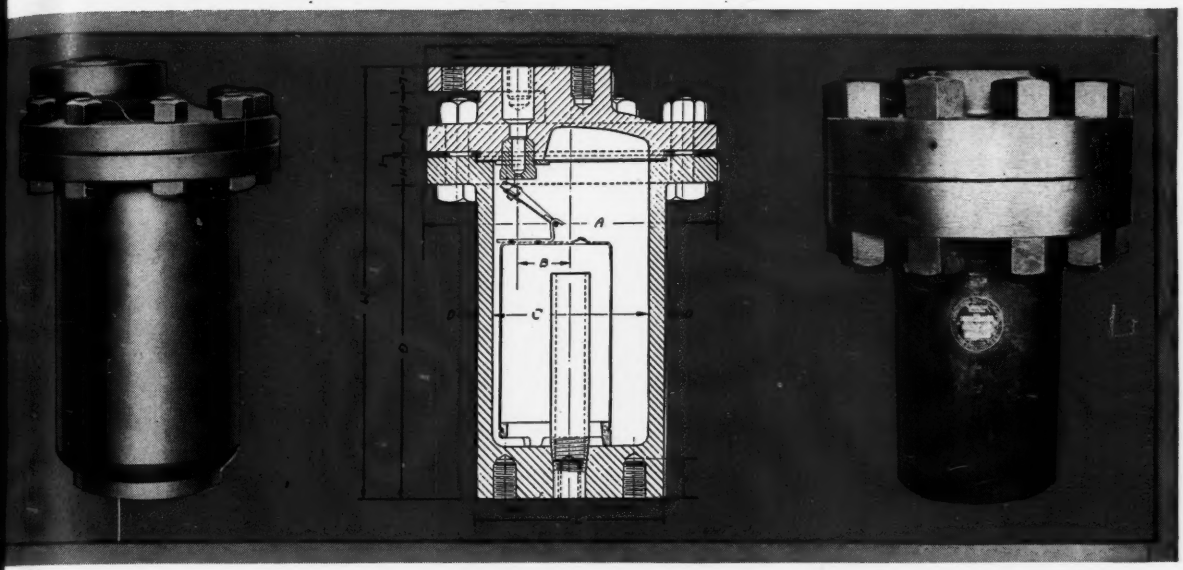
Above — Armstrong No. 315 and 515 Forged Steel Traps in a central station.

Left — Typical Armstrong trap applications in a modern power plant.

Right — Armstrong Forged Steel Traps at a Midwest utility plant.

ARMSTRONG

TRAPS ... for pressures up to 2400 lbs.



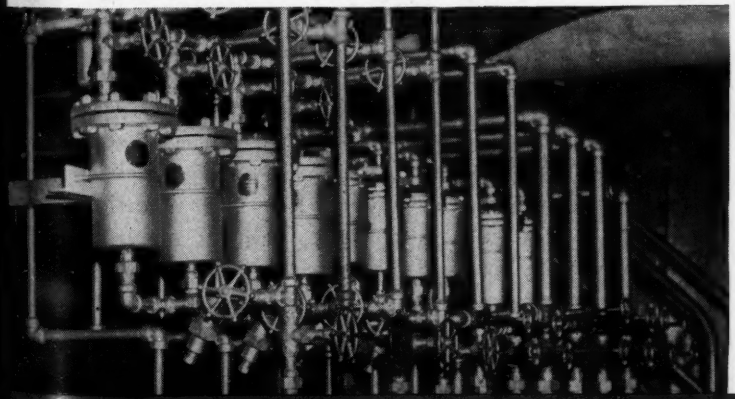
. . . with *flanged* connections

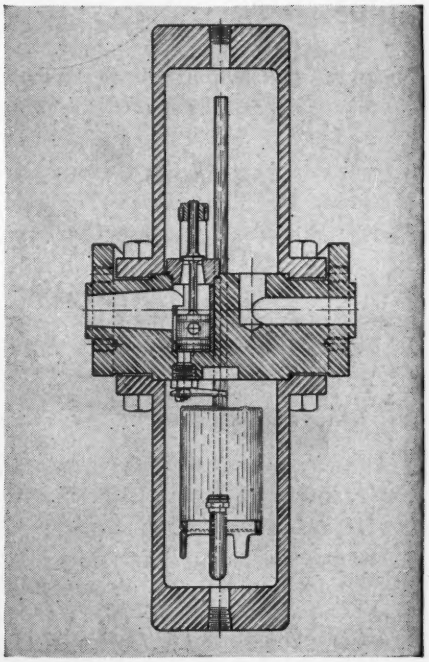
DEVELOPMENT over a period of years of the Armstrong line of forged steel steam traps has gone along with two trends in modern power plant design:

1. Elimination of all cast iron fittings.
2. Completely automatic condensate drainage.

Here are traps engineers like. Simple — dependable. High quality materials. Well designed and well built. A size and type for every application. Backed by nearly 40 years' experience and an unconditional guarantee.

Ask for a copy of the Armstrong **STEAM TRAP BOOK**, a helpful guide to the selection, installation and maintenance of traps.



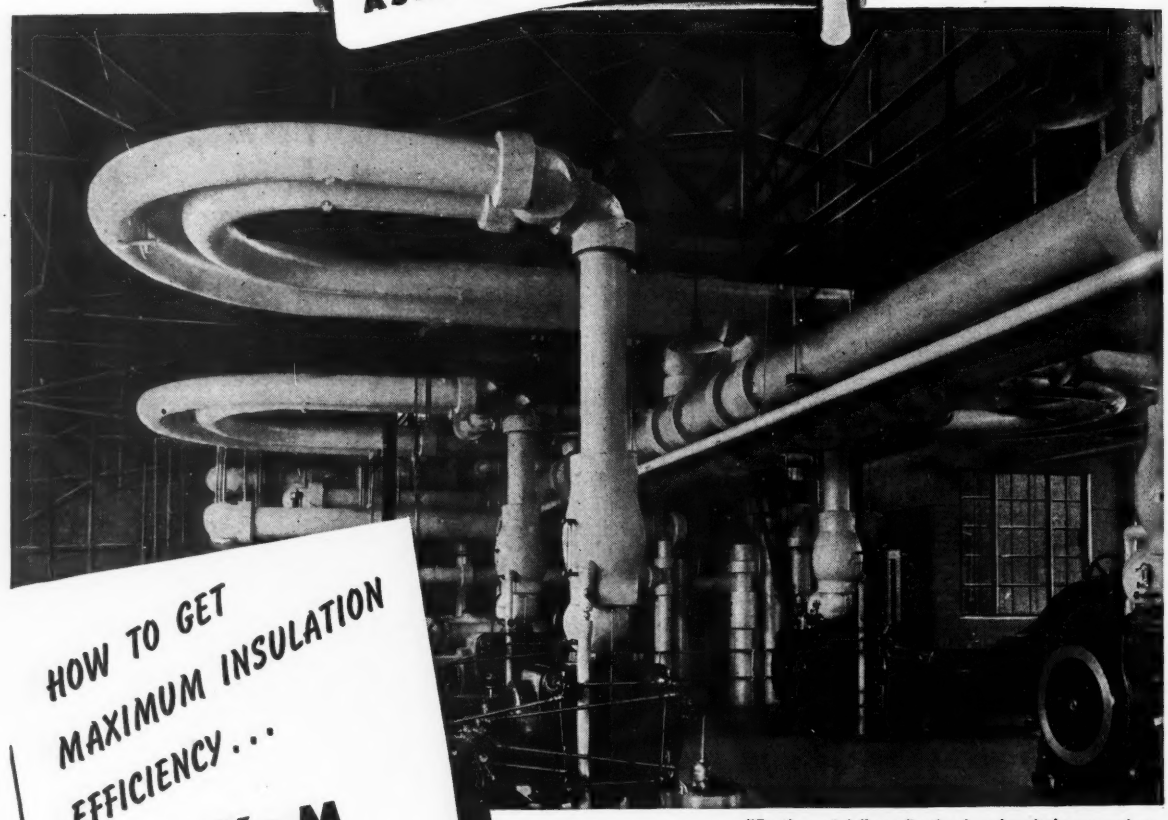


Armstrong Compound Trap

For large amounts of condensate. Capacities to 300,000 lbs. of condensate per hour at pressures to 600 psi. For draining steam purifiers and separators, flash tanks, continuous blow down systems, etc.

MACHINE WORKS
810 Maple Street
Three Rivers, Michigan

ASBESTOS IN ACTION



"Featherweight" application in a hospital power plant.

HOW TO GET MAXIMUM INSULATION EFFICIENCY...

use K&M "Featherweight" 85% Magnesia

By using "Featherweight" 85% Magnesia on *all pipe flanges* as well as on the pipes themselves, you insure maximum heat control and insulation efficiency. Actual service has shown "Featherweight" to be the most efficient insulation of the moulded type for temperatures up to 600° F.—when properly and completely applied.

Combining the structural strength of selected asbestos fibres with the high insulating qualities of carbonate of magnesia, "Featherweight" 85% Magnesia is extremely light in weight, absolutely fire-proof, and mechanically strong enough to withstand all the rigors of ordinary usage. Write us for recommendations applying to your specific requirements.

K&M best in asbestos

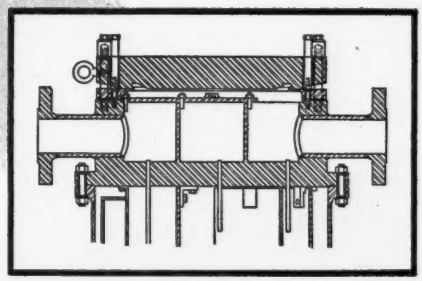
Nature made Asbestos

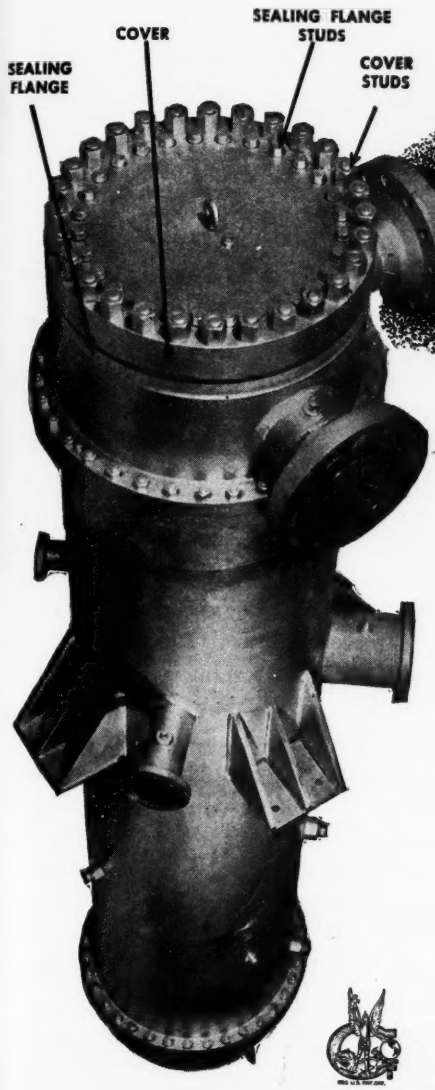
... Keasbey & Mattison has been making it serve mankind since 1873

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

A TIGHT HEAD-COVER JOINT

independent of main cover bolting and hydraulic load





IN THIS G-R EXTRACTION STEAM HEATER

No excessive wrench pull on the nuts is required to assure complete tightness of the head-cover joint gasket in the G-R Type Y Extraction Steam Heater.

This design has a separate sealing flange with an expansion member welded at its inner periphery to the cover. The cover carries the hydraulic load, and the sole function of the sealing flange is to provide only the necessary gasket contact pressure. The sealing flange is secured to the water head barrel by small studs with long nuts carried to the outside of the cover.

An additional advantage of the design is that the gasketed joint is visible, insuring immediate detection of any leak; and adjustment can be made without removing the head cover.

This is but one of the many distinctive features of G-R Extraction Steam Heaters. These heaters—available in a range of types for every pressure and capacity—are fully described in Bulletin 278 which will be sent on request.

THE GRISCOM-RUSSELL CO.

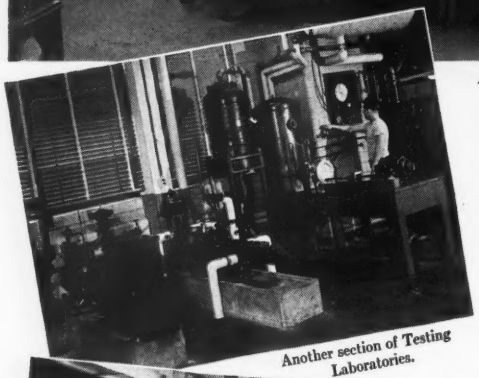
285 Madison Avenue **New York 17, N. Y.**

GR-128

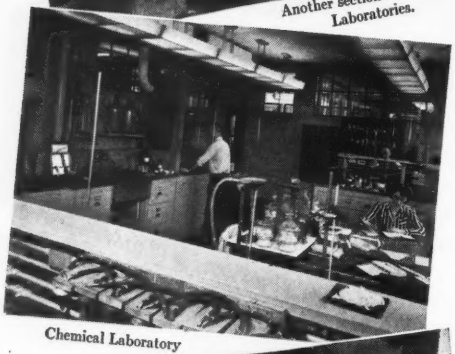
GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

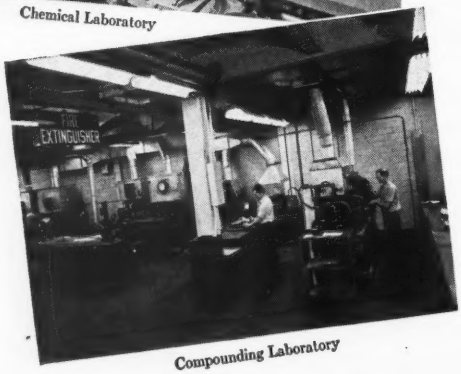
Above—Garlock Testing Laboratories, general view.



Another section of Testing Laboratories.



Chemical Laboratory



Compounding Laboratory

New, Modern Facilities—

For developing, improving and testing Garlock products

YEARS AGO, when little was known about the laws governing "packing mechanics," The Garlock Packing Company entered into research in the field of mechanical packings. Year by year, as new industrial equipment and processes came into use, Garlock's research expanded.

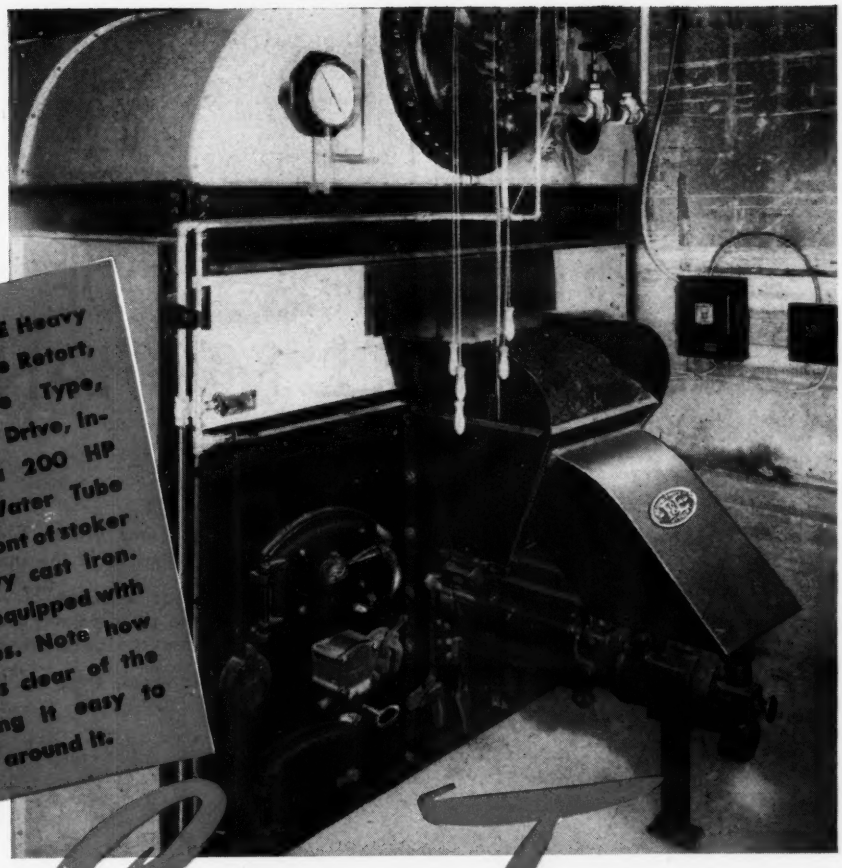
Garlock's latest forward step in that direction is a new modern, building at Palmyra housing a chemical laboratory with complete analytical and microscopic facilities; a physical laboratory; a rubber-compounding laboratory; an extensive test department; and a fully equipped pilot plant. These new facilities are staffed with able and experienced technicians whose entire time and efforts are devoted to the development of new products and processes; the improvement of old products; and the repeated testing under actual operating conditions of GARLOCK packings, gaskets and KLOZURE oil seals.

Every Garlock product is Quality Controlled from the raw material to the final finishing operation and has a background of scientifically measured performance. More than ever before Garlock merits its slogan—*The Standard Packing of the World.*

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company
of Canada Ltd., Montreal, Que.

GARLOCK



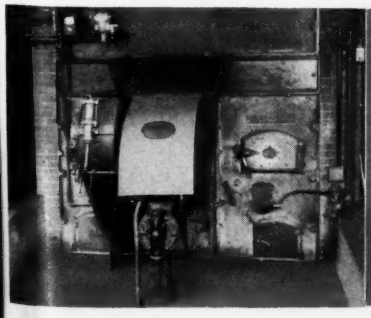
"F & E" Series 70-E Heavy Duty Stoker, Single Retort, Stationary Grate Type, Electro-Hydraulic Drive, installed under a 200 HP Water Wall, Water Tube Boiler. Entire front of stoker made of heavy cast iron. All fire doors equipped with safety latches. Note how the stoker is clear of the floor, making it easy to keep clean around it.

"F & E" SERIES 70-E UNDERFEED STOKERS

Sure-Fire

Powerful and positive in action, the Series 70-E Stoker with the "F & E" patented Electro-Hydraulic Drive will dependably feed and burn coal sufficient to generate up to 40,000 lbs. of steam per hour.

Recognized as the most simple and flexible . . . the most rugged and dependable stoker drive ever developed, the "F & E" Electro-Hydraulic Drive is trouble free under every fuel feeding condition. All working parts are fully enclosed and operate in oil. No pipes, valves or fittings to leak or give trouble.



Front view of "F & E" Series 70-E Electro-Hydraulic Drive Stoker, Unit Type, for capacities up to 18,000 lbs. of steam per hour. A constant speed electric motor operates the Electro-Hydraulic Drive, with power transmitted through a specially designed, high-duty, hydraulic gear pump, which in turn, supplies oil under pressure for operating the hydraulic cylinder and piston.

No gears, ratchets, shear pins or complicated mechanism to break down. "F & E" features include the interval timer governor that regulates Full Stroke, Full Speed ram action so essential to dependable steam generation. Result—*uninterrupted sure-fire* performance at all times!

Investigate "F & E" Stokers—check into the "F & E" combination of six engineered features that assure you dependable, *sure-fire* production of steam for your requirements.

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STREETS, BALTIMORE 2, MARYLAND

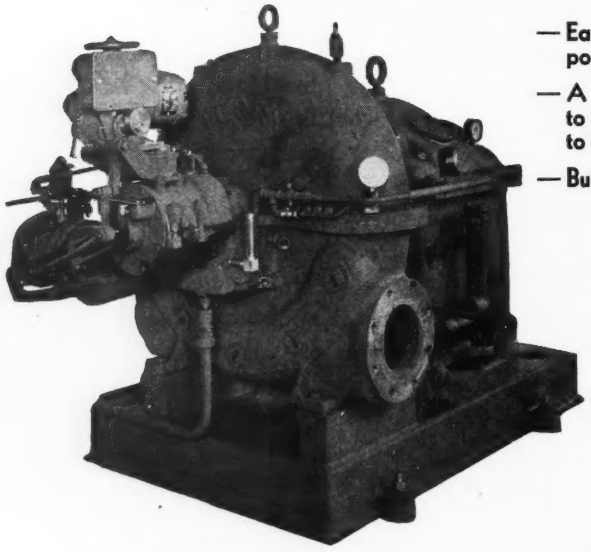
Representatives in Principal Cities

UNDERFEED STOKERS

HYDRAULIC DRIVE AND STEAM DRIVE FOR BOILERS PRODUCING 10,000 TO 40,000 LBS. OF STEAM PER HOUR

The TERRY

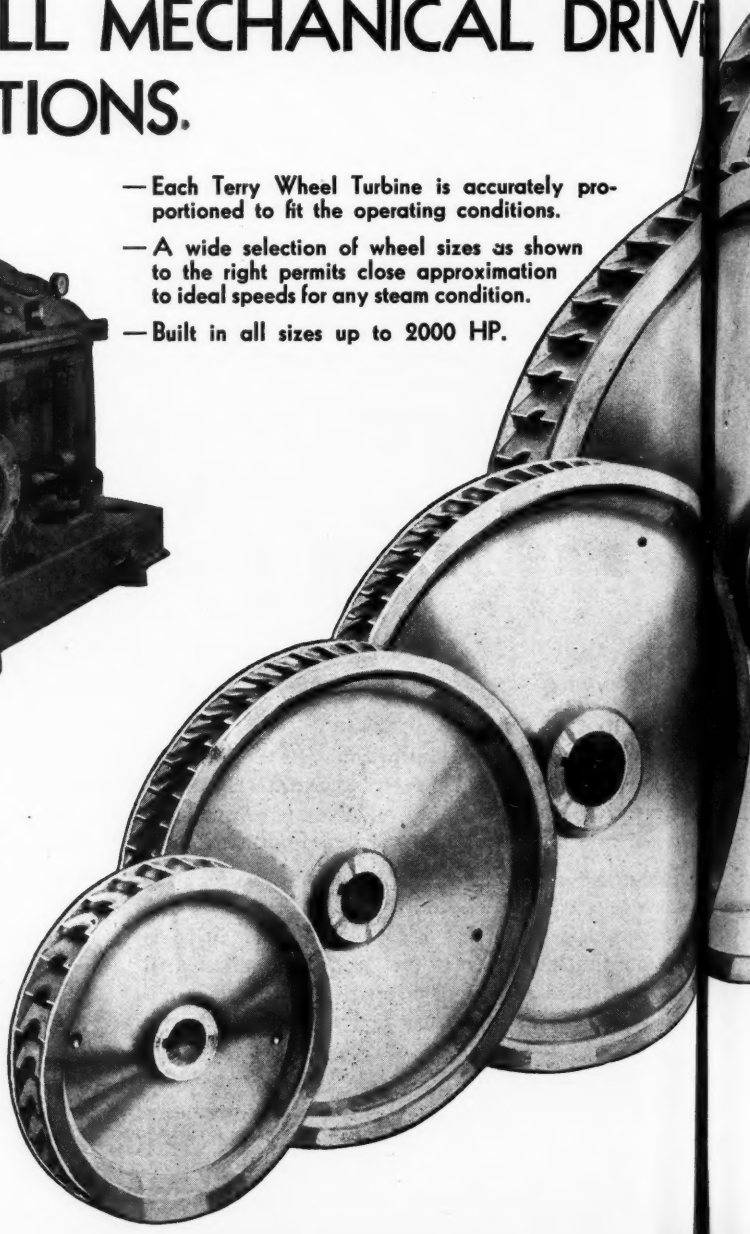
—IS BUILT IN A WIDE RANGE O SIZES FOR ALL MECHANICAL DRIV APPLICATIONS.



— Each Terry Wheel Turbine is accurately proportioned to fit the operating conditions.

— A wide selection of wheel sizes as shown to the right permits close approximation to ideal speeds for any steam condition.

— Built in all sizes up to 2000 HP.



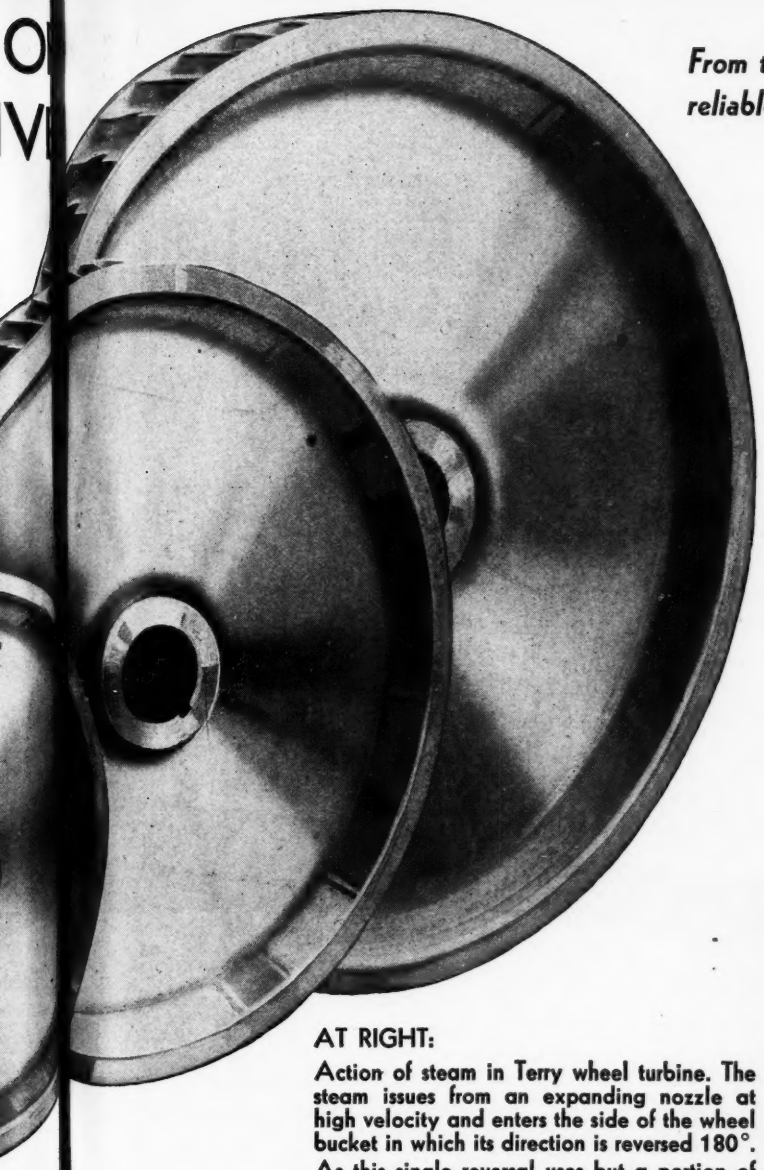
ABOVE:

Typical Terry Solid Wheel Turbo-Gear Unit. Rated 160 HP at 4000 to 1720 RPM with steam conditions of 400 lbs., 750°F.TT, 30 lbs. Used for Blower Drive.

FOR FULL DETAILS ASK FOR BULLETIN S-116

THE TERRY STEAM TURBINE CO.

Wheel Turbine

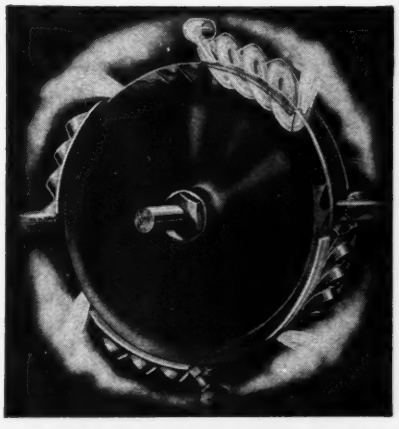


From the smallest to the largest these reliable turbines have—

- ★ Indestructible one piece wheel.
- ★ Large radial and axial clearances.
- ★ Double rim protected blading.
- ★ Individual nozzle control.
- ★ Dependable and durable governor.
- ★ Heavy dust-proof bearing and governor housing.
- ★ Independent overspeed trip with separate valve.
- ★ Sturdy casing design.
- ★ Strong and easily inspected steam strainer.
- ★ Truly accessible construction, which makes inspection of the interior parts a simple matter.

AT RIGHT:

Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.



T-1159

TERRY SQUARE - HARTFORD, CONN.

GRINNELL

PIPING PROGRESS

Steam Header — 18" O.D. x 7/8" wall, 13' 8 3/8" long. Carbon-Moly Turned and Bored Forging with solid, integral end-closure. One 12", three 10" and one 6" outlets.

Extruded Headers

Question: **How can headers be made with smooth inside contours, minimum friction to flow and requiring only plain circumferential butt welds . . . and still comply with Code requirements?**

Answer: **By the extruded nozzle process which permits the making of any number of any size outlets.**

Grinnell Extruded Nozzles are made by a patented hydraulic forming process. Outlets can be extruded up to and including full size. Inside contours are smooth, assuring minimum friction to flow. Welding ends are machined to same wall thickness as abutting pipe. Only circumferential butt welds are required.

WHENEVER **PIPING** IS INVOLVED

Typical of Grinnell's advanced pipe fabrication facilities is this forming process for outlets in headers which simplifies erection of piping on the job by elminating difficult intersection type welds. They are made possible by this company's 95 years of piping experience and continuous laboratory research and experimentation.

Whenever piping is involved—Grinnell has the specialized knowledge, field engineering experience and the production facilities to handle the job from first plan to actual operation. From this one source you can get everything from a tiny tube fitting to a complete power or process piping installation.

GRINNELL COMPANY, INC., Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

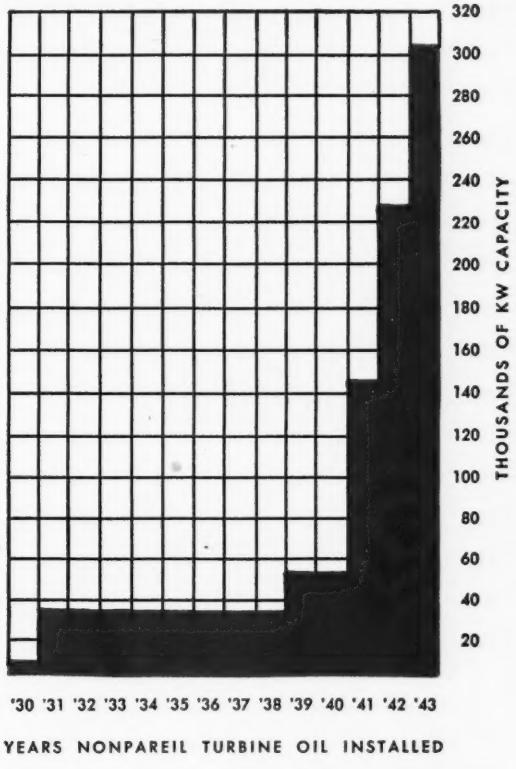
GRINNELL

FOUNDED 1850

WHENEVER **PIPING** IS INVOLVED

A turbine oil that sells itself in the turbine...

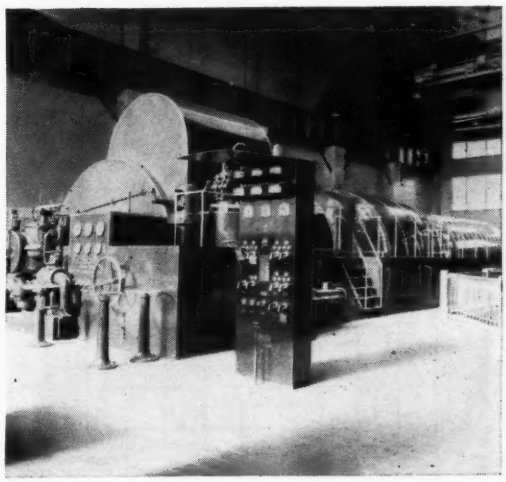
NONPAREIL
TURBINE OIL



HERE'S HOW Nonpareil, once installed in a turbine, sells itself to the user. A large Wisconsin utility company installed Nonpareil 16 years ago in one small unit. The chart at right shows how, year after year, turbine after turbine was put on Nonpareil as this power system grew.

Cleaner operation, continuous low acidity without oil treating, and guaranteed performance for the life of the turbine are some of the reasons why users install Nonpareil as new turbines are put into service.

A Standard Oil Lubrication Engineer can detail many advantages you'll get by filling your turbine with Nonpareil. Write Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois, for the nearest Engineer.



One of the two 80,000 KW turbines recently installed in a Wisconsin utility system in which Nonpareil is used. Equipment totaling over 300,000 KW is being lubricated by Nonpareil for this operator.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Fewer oil changes... less deposit with improved

STANOIL

FOR 18 YEARS Standard has provided an oil containing additives to reduce oil oxidation and formation of acidity and deposits in turbines.

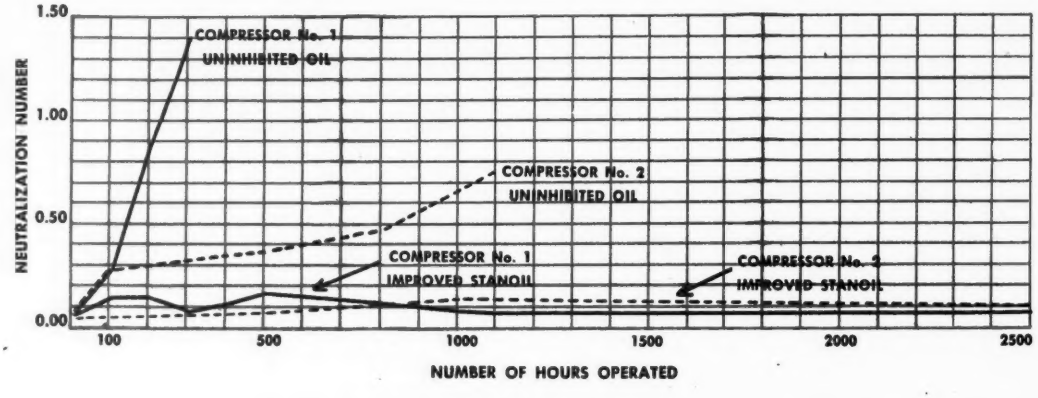
Now Standard has developed and incorporated in Stanoil an additive which improves oxidation resistance for a wide range of industrial applications. Improved Stanoil has been tested under the most severe operating conditions on many types of service: compressors, reduction gears, circulating and hydraulic systems.

Records of one of these severe tests in two compressors are charted below. They show the greatly reduced rate of acidity formation in Improved Stanoil as compared with oils previously used.

Try Improved Stanoil. Compare oil replacement records with the oil you now use in gear cases, circulating and hydraulic systems. Note how Stanoil reduces deposits in compressors.

A Standard Oil Lubrication Engineer will help you make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

Adverse operating conditions and 24-hour a day operation imposed severe demands on the lubricating oil in two mine compressors. Conventional oil rapidly increased in acidity, as shown by the chart. Improved Stanoil maintained a safe low acidity throughout the 2500 hour test on Compressor No. 1 and for an additional 700 hours on Compressor No. 2 until it was shut down. Make-up was comparable with both oils.

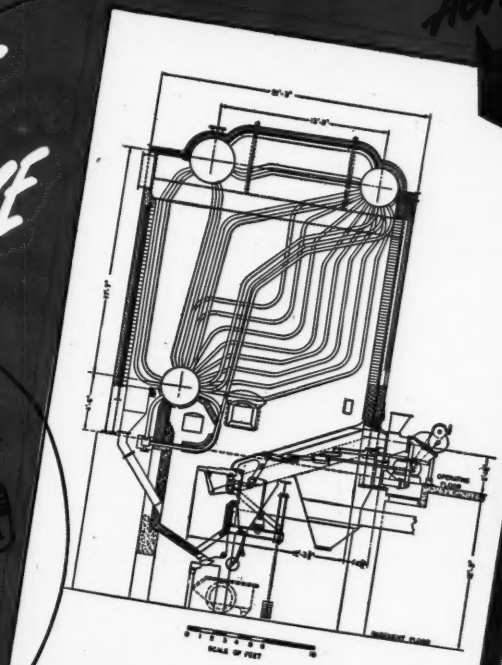


STANDARD OIL COMPANY (INDIANA)

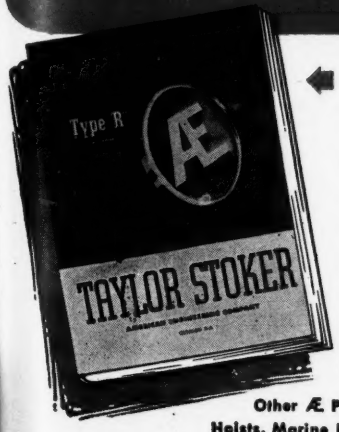
STANDARD SERVICE

Repeat Orders PROVE PERFORMANCE

AGAIN in 1944 1934 1920



A world famous manufacturer of drugs has completed its 3rd installation of Æ Taylor Stokers with the type R. This 6 retort, 25 tuyere continuous ash discharge stoker develops 50,000 lbs. per hour continuous steaming capacity.



GET THE FACTS ON THE IMPROVED TYPE R

This easy to read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operations as provided by the Æ Taylor Stoker. Write for it!

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

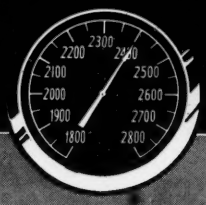
The Only Underfeed Stoker with *all* these Features IN COMBINATION!

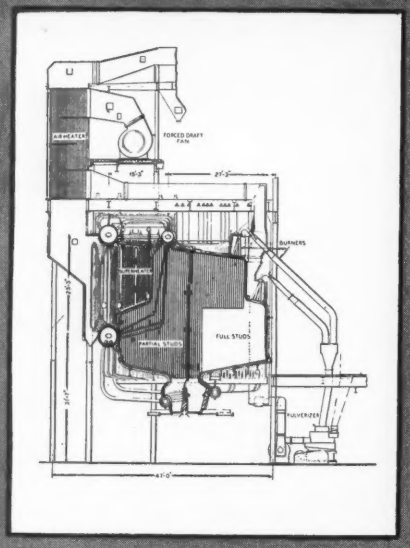
1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

Other Æ Products: Æ-Perfect Spread Stoker, Le-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

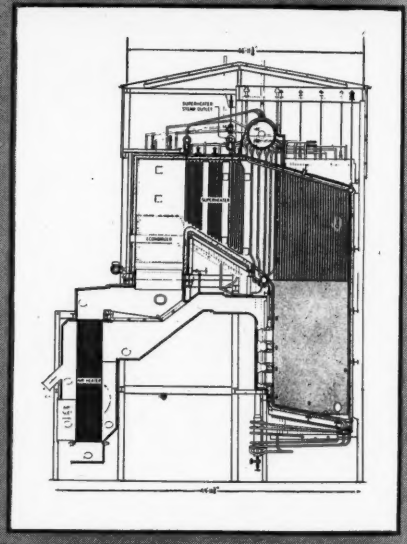
2408 ARAMINGO AVENUE, PHILADELPHIA 25, PA.



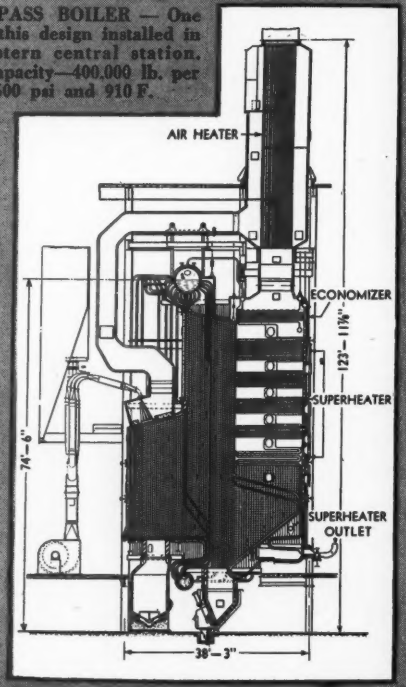


STIRLING BOILER—Four units of this special design installed in mid-western central station. Steam capacity each—350,000 lb. per hr. at 925 psi and 900 F.

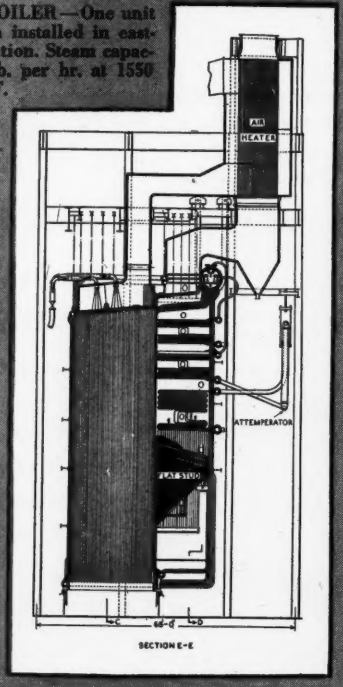
RADIANT BOILER—Twelve units of this design installed in Pacific Coast central stations. Steam capacity each—200,000 lb. per hr. at 1525 psi and 950 F.



OPEN-PASS BOILER—One unit of this design installed in mid-western central station. Steam capacity—400,000 lb. per hr. at 1500 psi and 910 F.

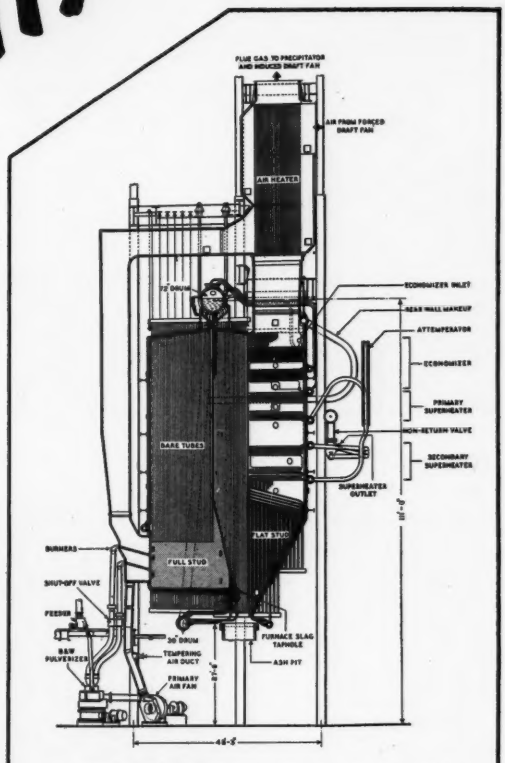


RADIANT BOILER—One unit of this design installed in eastern central station. Steam capacity—800,000 lb. per hr. at 1550 psi and 925 F.



ANY STEAM CAPACITY with B&W Boiler Designs

HIGHEST standards of performance with respect to continuity of service, dependability, over-all operating efficiency, and greatest return on investment, are assured when any job of supplying steam requirements for electric power generation is entrusted to B&W Boilers. From the time-tested, performance-proved B&W boiler designs — Open Pass, Radiant, High Head, Stirling and Integral-Furnace — you can always be sure of getting units having features necessary to provide economical steam generation under any combination of pressure, temperature, fuel and space requirements consistent with modern boiler applications. When you call on B&W for boilers and related equipment you call on a background of over 60 years' unsurpassed experience in designing and building steam generating units that have achieved a long record of highly satisfactory service in public utility stations in all sections of the United States. Among the recent installations of B&W boilers in this field are the designs shown on these pages.

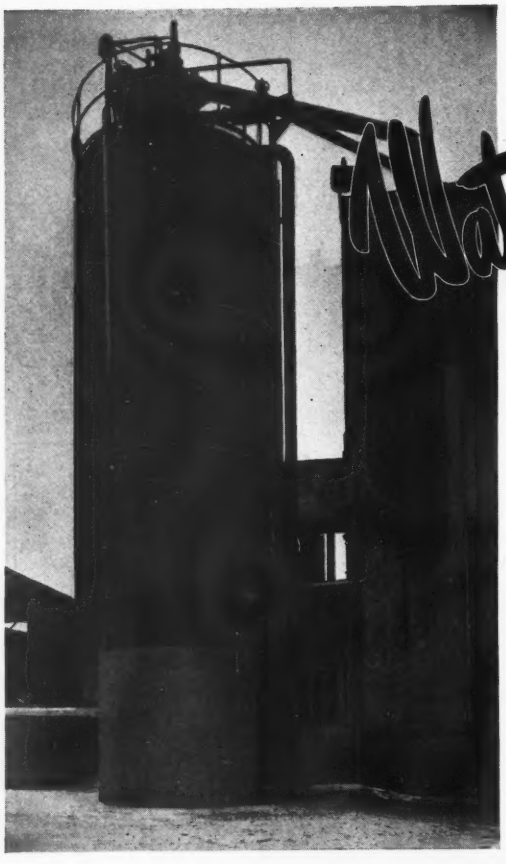


OPEN-PASS BOILER — Two units of this design installed in eastern central station. Steam capacity each—975,000 lb. per hr. at 1100 psi and 950 F.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.



Water Conditioning at a LARGE WESTERN COAL COMPANY

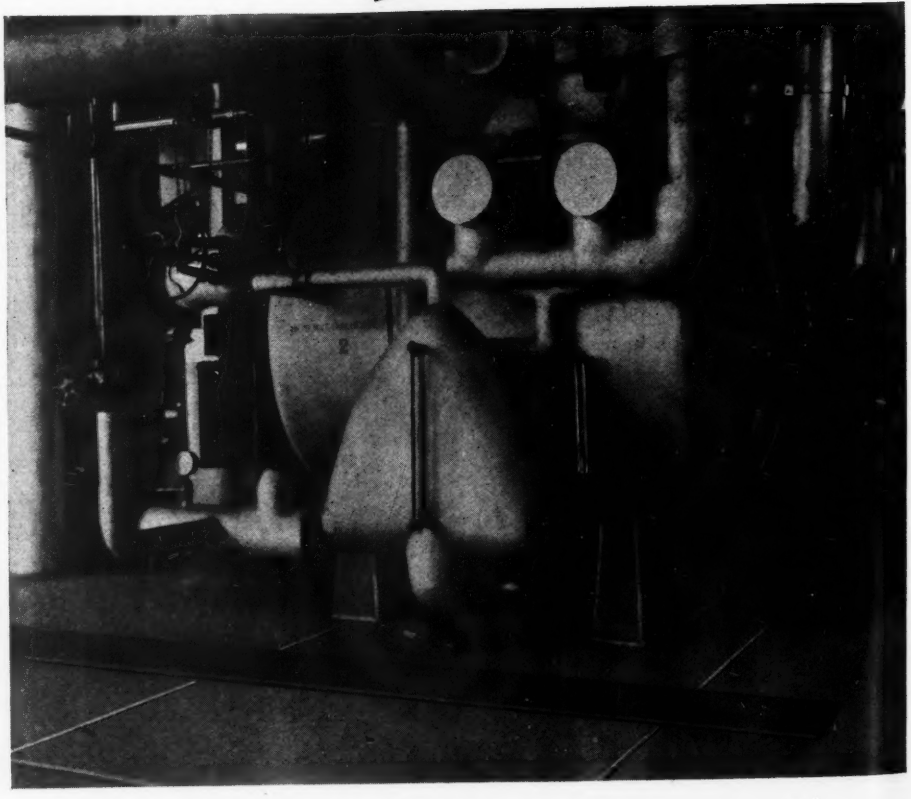
An interesting example of boiler plant water conditioning is the Cochrane installation illustrated here. Shown in the upper photograph is the sedimentation tank of the Cochrane Hot-Process Softener of 16,000 GPH capacity installed outside the building. The lower photograph shows the Cochrane rolled plate Deaerator of 150,000 lbs./hr. capacity mounted on a rolled plate storage tank. Two Cochrane filters and chemical tanks supplement this equipment and are in addition to identical equipment installed in 1936.

The performance of Cochrane Water Conditioning Equipment in industrial applications over the past three-quarters of a century and the reputation of Cochrane engineering in the field of water conditioning are responsible for the continued preference for Cochrane. This experience and knowledge continues unchanged in the organization that is ready to solve your water conditioning problems today. Write for any information you may require along these lines.

COCHRANE CORPORATION
3123 NORTH 17th STREET • PHILADELPHIA 32, PA.

COCHRANE
SINCE 1863

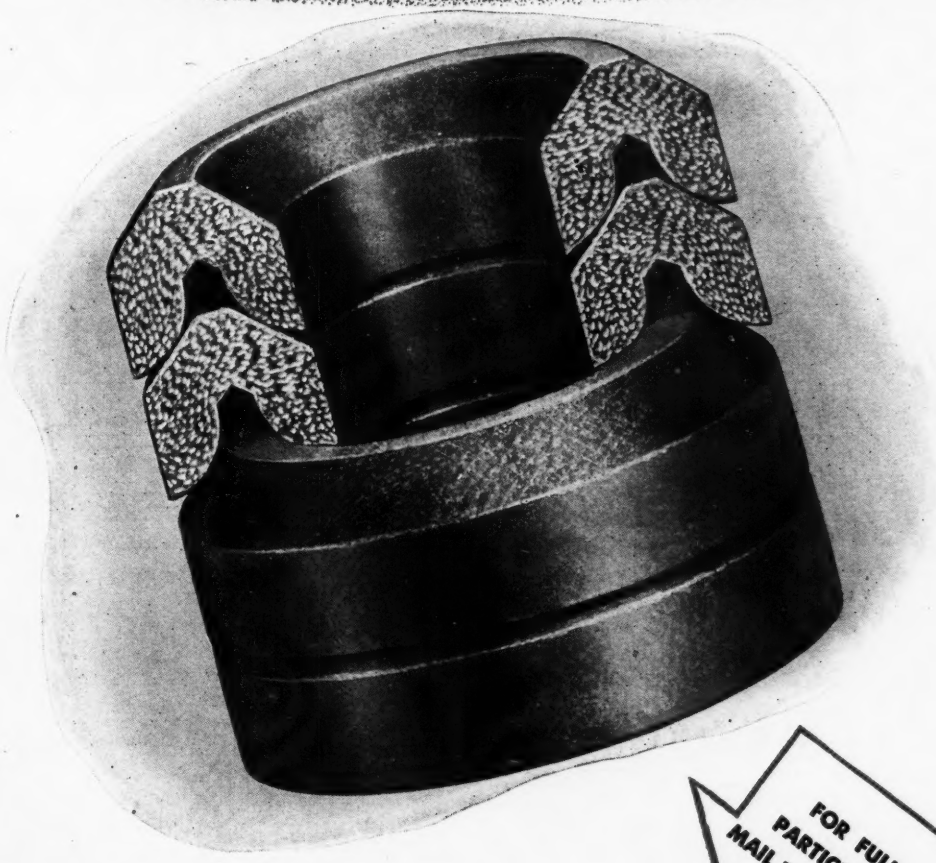
(Above) Sedimentation tank of 16,000 GPH installed outside building.



(Right) Cochrane Deaerator of 150,000 lbs./hr. mounted on rolled steel plate storage tank.

PALMETTO *Pyramid*

THE MOST TALKED ABOUT IMPROVEMENT IN MOLDED "VEE" PACKINGS



Engineers everywhere are talking about the newest addition to the PALMETTO family. PALMETTO Pyramid, a new design principle in all-purpose molded "Vee" type packings, seals completely with simple finger-tightening . . . and is *entirely automatic* in performance. A unique "arrowhead reservoir" stores and distributes lubricant. The result is reduced friction and less wear and that means longer packing life and longer equipment life.

FOR FULL PARTICULARS MAIL THE COUPON PLEASE

GT-1666

GREENE, TWEED & CO.
New York 66, N .Y.

☐ Send descriptive literature covering PALMETTO Pyramid Packings

☐ Send PALMETTO representative to discuss packing

Name .....

Company .....

Street .....

City ..... *State* .....

GREENE, TWEED & CO.

Manufacturers of PALMETTO Packings

BRONX BLVD. AT 238th ST. NEW YORK 66, N. Y.

Plants at New York, N. Y. and North Wales, Pa.

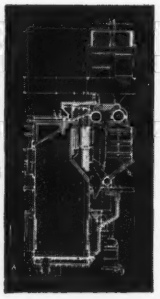
★ MORE THAN 5 MILLION

Represented by these Utility Repeat

SHERMAN CREEK Repeats

WITH ANOTHER MILLION-POUND UNIT

A C-E Steam Generating Unit, designed for a pressure of 1800 psi, a total steam temperature of 955 F and a capacity of 1,000,000 lb of steam per hr, was placed in service in 1945 by the Consolidated Edison Company of New York at Sherman Creek Station. . . . A duplicate unit has recently been ordered.



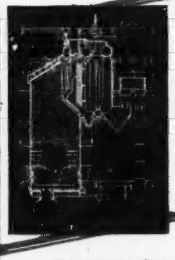
COMBUSTION ENGINEERING

HARDING ST. STATION REPEATS

with another 400,000 lb. unit

A C-E Steam Generating Unit, designed for a pressure of 375 psi, a total steam temperature of 900 F and a maximum steam capacity of 400,000 lb of steam per hr, was placed in service in 1942 by the Indianapolis Power & Light Company as their Harding Street Power Station.

A duplicate unit has recently been ordered.



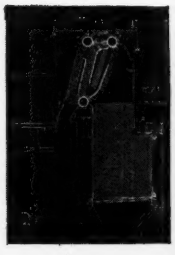
COMBUSTION ENGINEERING CO., Inc.
200 MADISON AVENUE, NEW YORK 16, N. Y.

PORT WASHINGTON Repeats

FOR THE SECOND TIME

A C-E Steam Generating Unit, designed for a pressure of 1250 psi, a total steam temperature of 830 F and a maximum continuous steam capacity of 680,000 lb of steam per hour was placed in service late in 1935 by Wisconsin Electric Power Company at its Port Washington Station.

A unit of the same type was purchased in 1940. And now a third unit has been ordered.



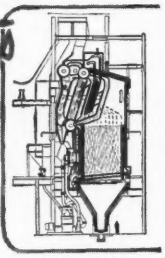
COMBUSTION ENGINEERING

MONTVILLE Repeats

WITH ANOTHER BIG C-E UNIT

Two C-E Steam Generating Units, each designed for a pressure of 725 psi, a total steam temperature of 825 F and a maximum capacity of 250,000 lb of steam per hr, were placed in service in 1937 by the Connecticut Light and Power Company at its Montville Station.

A 300,000 lb capacity unit, designed for a steam pressure of 970 psi and total temperature of 910 F has recently been ordered.



COMBUSTION ENGINEERING

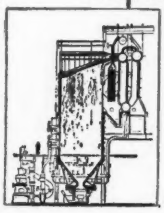
ROCHESTER Repeats

with another BIG unit

A C-E Steam Generating Unit, designed for a pressure of 750 psi, a total steam temperature of 755 F and a maximum continuous capacity of 250,000 lb of steam per hr was placed in service in 1936 by the Rochester Gas & Electric Company in Station No. 5. Similar units were added in 1937, 1938 and 1940.

In 1942 a larger unit of 300,000 lb capacity, but for 825 F total steam temperature, was added.

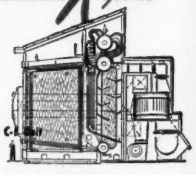
Recently a fifth unit of 400,000 lb capacity was purchased.



COMBUSTION ENGINEERING
200 MADISON AVENUE, NEW YORK 16, N. Y.

SOUTH OMAHA STATION Repeats

with another C-E unit



Two C-E Steam Generating Units of the "Outdoor" type shown above were placed in service in 1928 by the Nebraska Power Company, Omaha, Nebraska at South Omaha Steam Electric Station. These were C-E Units, Type VU, designed for a pressure of 525 psi, total steam temperature of 760 F and a maximum continuous capacity of 300,000 lb of steam per hour.

Another of these Outdoor units has recently been ordered.

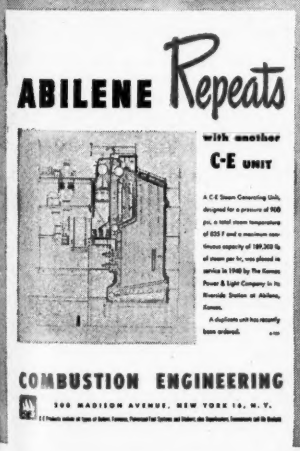
Combustion Engineering

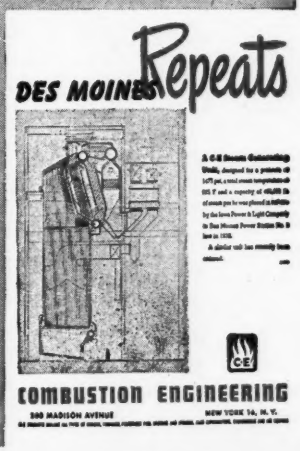
COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

POUNDS OF STEAM PER HOUR

Orders for CE Units over 1-year period

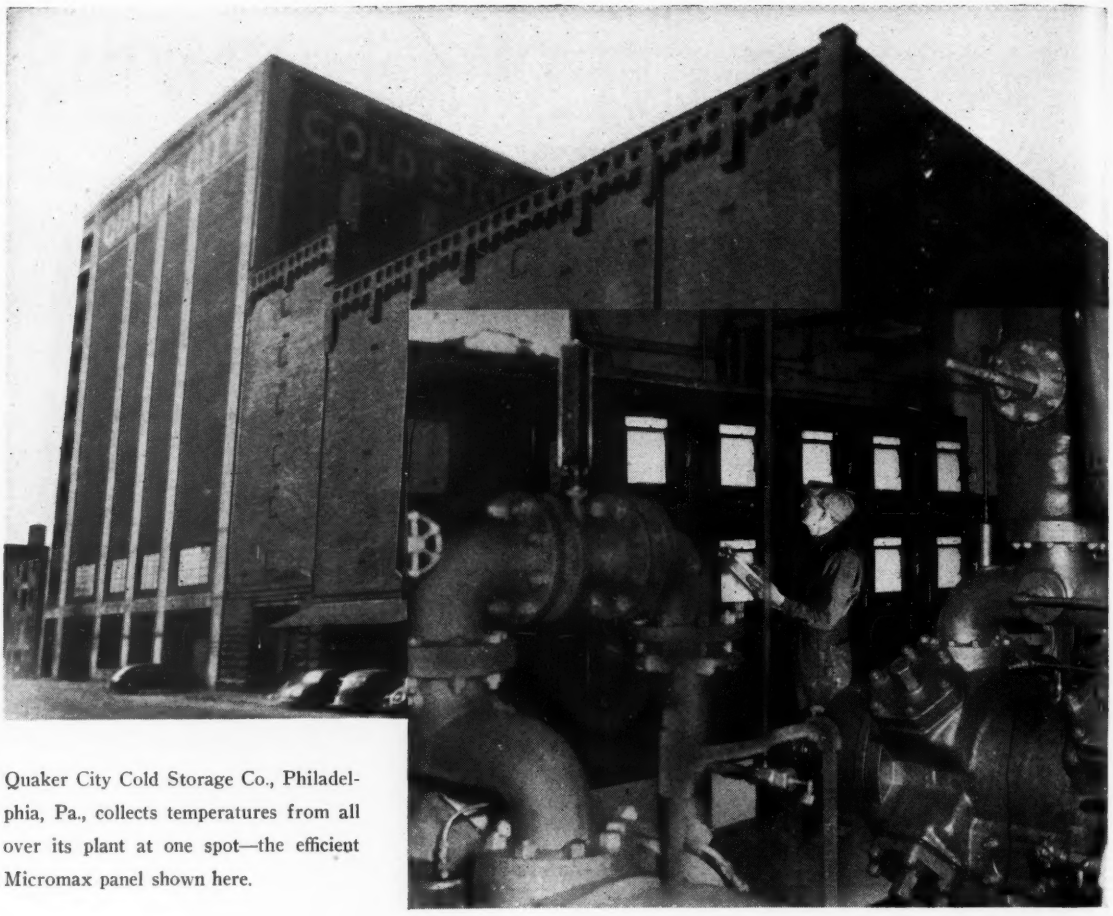




★ *Above are reproductions of advertisements published during period June 1945—June 1946 featuring repeat orders for C-E utility units with capacities ranging from 190,000 to 1,000,000 lb steam per hr.*

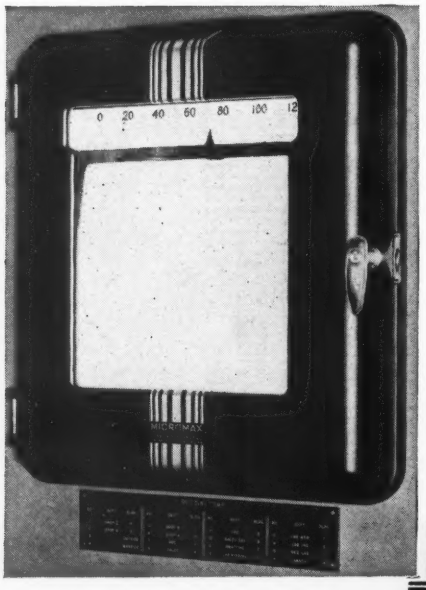
ENGINEERING A-980

200 MADISON AVENUE, NEW YORK 16, N. Y.



Quaker City Cold Storage Co., Philadelphia, Pa., collects temperatures from all over its plant at one spot—the efficient Micromax panel shown here.

Big Buildings Save Big Sums with Micromax Temperature Recorders



Typical Micromax Recorder, mounted on panel, for providing accurate information about building temperatures.

The daily miles of walking required to read temperatures in the big Quaker City building shrank to a few yards when Micromax instruments centralized the job of temperature recording. And this is just one reason why Micromax saves time, effort and money for efficiency-minded building managers. Along with the reduction in labor, temperature changes are reported more quickly and therefore corrected more promptly. This gives not only a substantial saving in power, but also a smoother temperature curve for each building area.

Micromax instruments are fitted for this job by their proved ability to record accurately as many as 16 temperatures per instrument, either near or remote. Fully automatic operation plus sturdiness of all parts of the equipment reduce instrument care to a minimum.

If you have the problem of reading scattered temperatures, you'll find valuable information in Catalog N-33A (Micromax Thermocouple Pyrometers) or Catalog N-33C (Thermohms), sent on request. Or, if you'll outline your specific needs, we'll send the detailed recommendation of an L&N engineer.

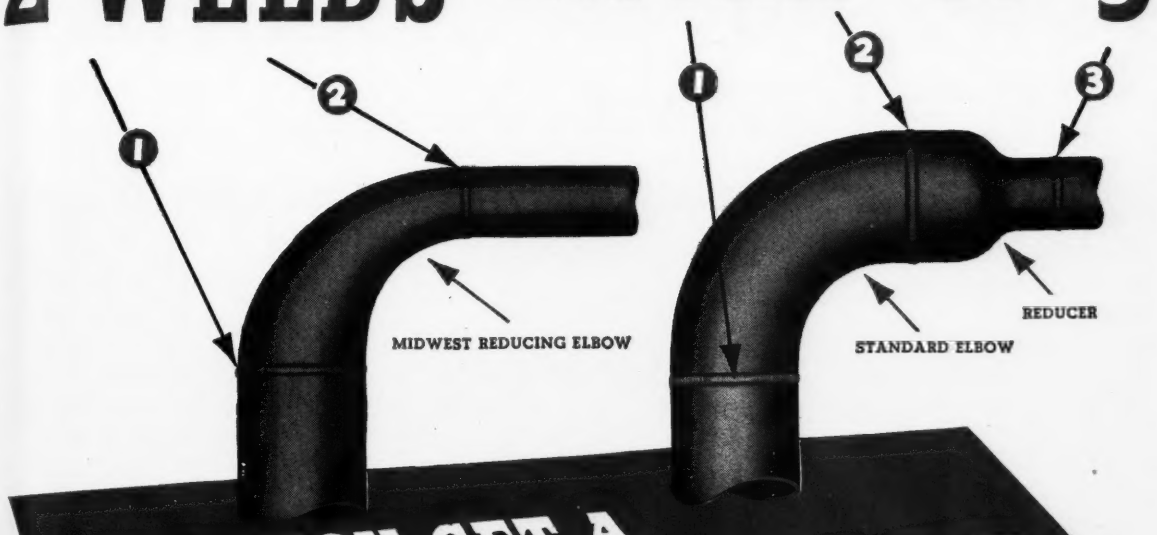
LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

JRL AD N-33-220(1)

2 WELDS INSTEAD OF 3



AND YOU GET A BETTER PIPING JOB

MIDWEST

REDUCING WELDING ELBOW

- SAVES WELDING
- SAVES MONEY
- SAVES TIME
- REDUCES TURBULENCE
- IMPROVES APPEARANCE

One weld is eliminated when the Midwest Reducing Elbow is used to change both direction and pipe size in a welded pipe line . . . you make only two welds instead of three. This exclusive Midwest Fitting takes the place of both a standard elbow and a reducer, as shown above. This saves time and money, produces a smoother, cleaner, better appearing job. In addition, the gradual reduction, smooth curve and absence of abrupt neck reduce turbulence. Insulation is also easier.

All the advantages of Midwest Standard Elbows are to be found in Midwest Reducing Elbows . . . unusual dimensional accuracy, beneficial effect of working metal in compression, stress relieving, etc. Center-to-end dimensions are the same as for standard elbows with which they are interchangeable.

This reducing elbow is one of many Midwest Welding Fittings designed to reduce the cost and improve the quality of welded piping. Write for Bulletin WF-41 for complete information.

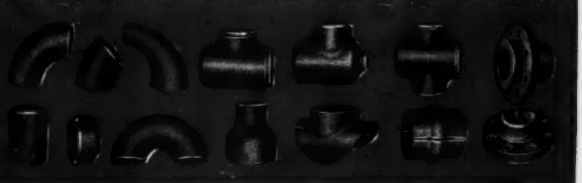
MIDWEST

PIPING & SUPPLY COMPANY, Inc.

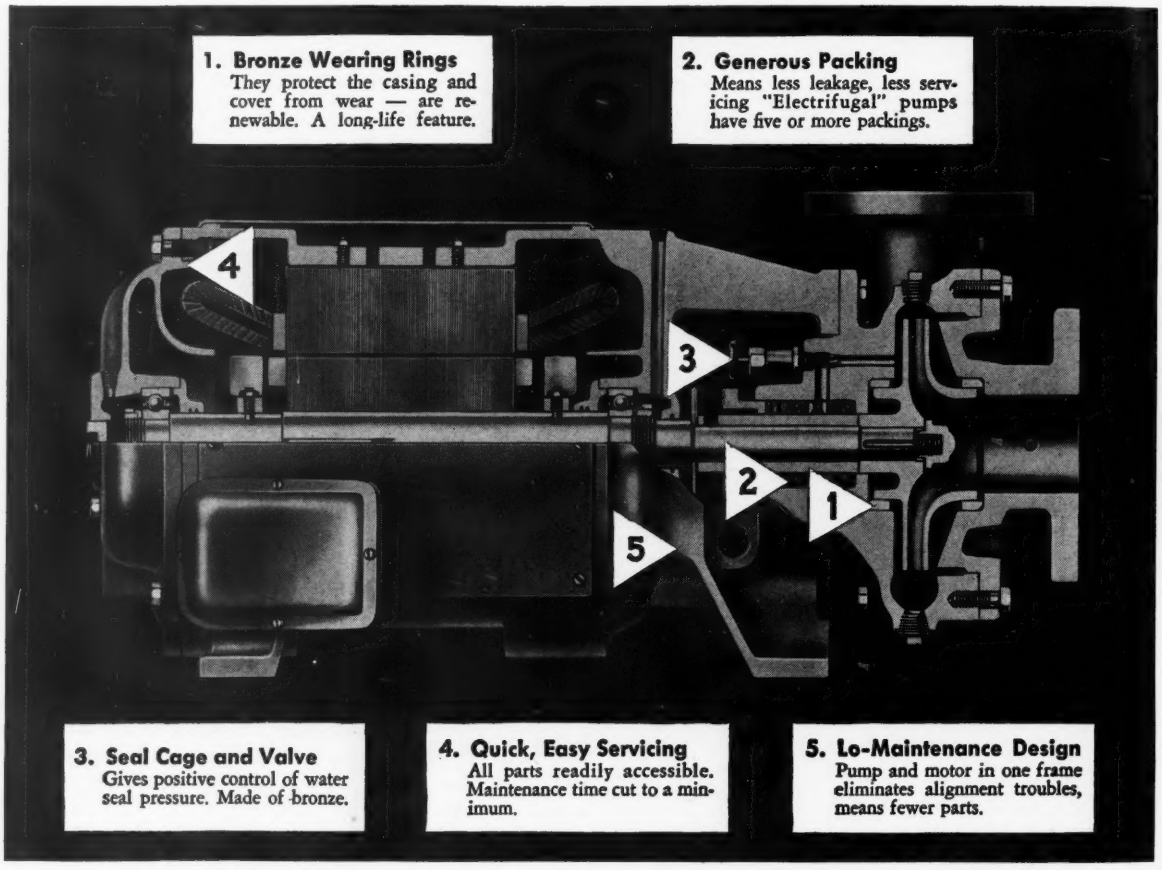
Main Office: 1450 South Second St., St. Louis 4, Mo.

Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities.

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS



CONSTRUCTION DETAILS
that cut pump maintenance costs


1. Bronze Wearing Rings
They protect the casing and cover from wear — are renewable. A long-life feature.
2. Generous Packing
Means less leakage, less servicing "Electrifugal" pumps have five or more packings.
4
3
2
1
5
3. Seal Cage and Valve
Gives positive control of water seal pressure. Made of bronze.
4. Quick, Easy Servicing
All parts readily accessible. Maintenance time cut to a minimum.
5. Lo-Maintenance Design
Pump and motor in one frame eliminates alignment troubles, means fewer parts.

GET THEM ALL...

These fine-construction features are guide-posts to longer service — lower pumping costs. Look for them in the pump you buy.

You get them all — and more — in an Allis-Chalmers "Electrifugal" pump. By mounting pump and motor on the same shaft and in the same frame, Allis-Chalmers engineers not only save space, but they simplify construction and reduce cost. They give you a pump that's quickly installed — operates in any position — has almost endless applications. Made in stock sizes from ¾ to 25 hp.

PART OF THE COMPLETE LINE

Other Allis-Chalmers centrifugal pumps and motors in capacities to 170,000 gpm! Single suction, double suction and multi-stage. Call your Allis-Chalmers office or dealer — or write for bulletin No. B6018. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2038

ALLIS CHALMERS *Electrifugal* **PUMPS**

CONDENSERS FOR CUBA

Foster Wheeler condenser passing the *Maine* Memorial, Havana, Cuba. This 60,000 lb. condenser traveled 1,500 miles by rail, ship and truck from Foster Wheeler's Carteret, New Jersey plant to Havana.

Designed for a Cuban textile mill, the surface condenser illustrated is a two pass direct flow type with more than 6½ miles of ¾" tubing.

Serving a 5,000 KW automatic extraction turbine and condensing a maximum 60,000 lb. of steam per hour, this condenser is designed to handle widely varying loads at required vacuum.

Differential spacing of tubes, a Foster Wheeler development, insures uniform penetration of steam to all condensing surfaces.

Experience has proved conclusively that the five basic requirements of an efficient condenser are distribution, penetration, air scavenging, devaporization and high condensate temperature. Foster Wheeler designs, product of fifty years' practical application in condenser engineering and construction, certify technical excellence in meeting these requirements.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.

FOSTER WHEELER

Betz Offers
SPECIALIZED CONSULTING SERVICE

The activities of the Betz organization are by no means limited to the regular chemical conditioning and control of boiler and cooling waters. Typical of the completeness and diversification of services offered in the field of water conditioning are those of the Consulting Division. Here is an entirely separate unit, staffed with chemical, mechanical and sanitary engineers, qualified through years of collective experience to make unbiased recommendations for the solution of problems involving the conditioning of industrial or municipal water supplies—or for treatment and disposal of industrial wastes.

Many, if not most water or waste treatment problems are so unique in character as to require study by specialists in order to reach a solution that is both operationally and economically feasible. Such studies made by the staff of our Consulting Division have saved money, effort and production time for hundreds of plants.

The Betz organization has a force of over forty field engineers located in industrial centers throughout this country, Canada and Mexico. These men, at no obligation to you, will be glad to call for a personal discussion of these consulting services, or write to the main office direct for additional details.

the consulting division of

***SEND FOR** the illustrated brochure which gives a complete outline of Betz Consulting Division Services—their fields of application—the manner in which they are extended—and typical functional design drawings of actual treatment plants. Ask for the Consulting Division Booklet-"B" W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Penna.*

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING
INDUSTRIAL WASTE TREATMENT

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.

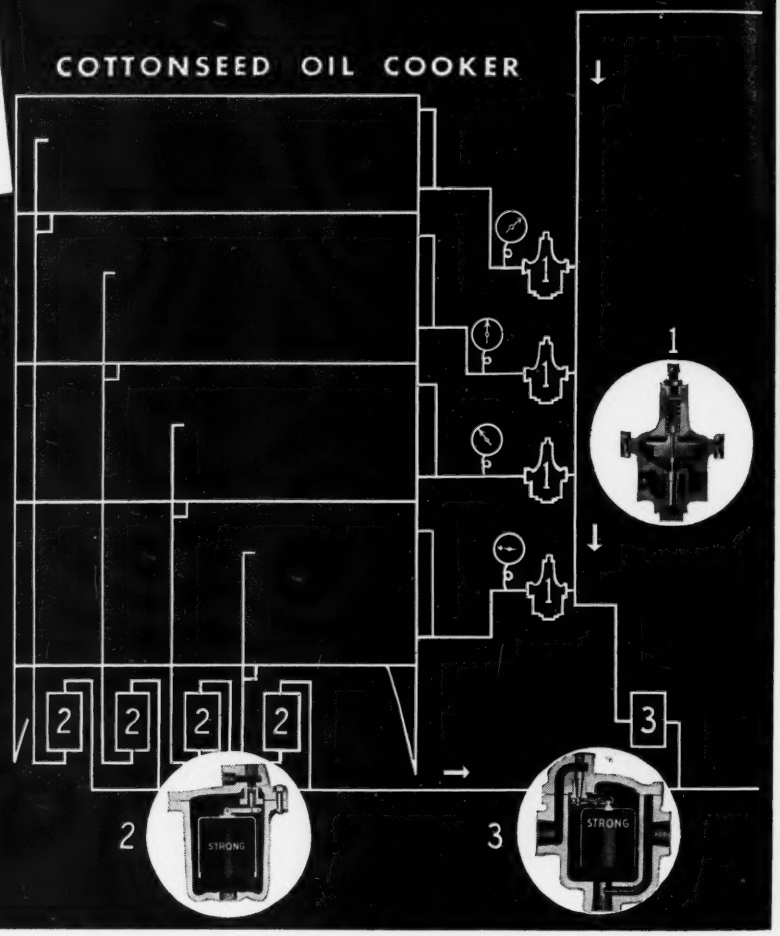
Double Problem in Steam

1 Control and variation of temperatures in four steam sections.

2 Correct drainage to insure maintenance of cooking temperatures.

HERE'S STRONG'S *Suggestion:*

1. Since temperature varies directly with steam pressure install Strong's variable pressure reducing valves (Type K with Anum-Metl disc and seat and integral strainer) on inlets of each section. Pressure gauges in reduced side of line provide easy visual control, eliminating maintenance of temperature regulator bulbs.
2. Use Strong's Series 80 inverted bucket traps with Anum-Metl valves and seats to drain each section. Insure positive drainage and uniform cooking of meats.
3. Small Strong series 70 inverted bucket trap with Anum-Metl valve and seat drains main header, insuring a constant supply of live steam at each reducing valve.



Time-temperature processes depend on both!

Cottonseed cookers, in common with all time-temperature steam processes, require both accurate pressure control and complete, automatic condensate removal. In this case, bright, high-quality oils depend upon how accurately equipment operates.

Knowing the problems involved, and having the steam specialties needed to solve them, Strong steam engineers can give unbiased, practical recommendations that insure satisfactory operation of your time-temperature processes. This calls for close attention to drainage equipment to fit the variables in each installation, determine peak loads, time required to reach temperature, etc.

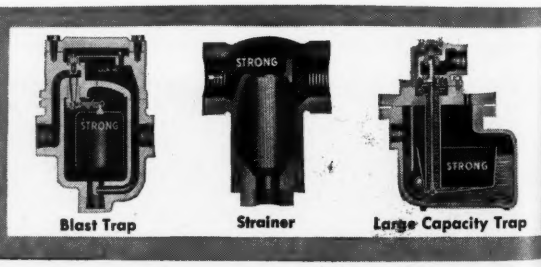
For any trap need, open or inverted bucket, float, float and thermostatic—in cast or semi-steel, forged or welded construction—call on

STRONG, CARLISLE & HAMMOND CO., Cleveland 13, O.

REG. TRADE MARK

OTHER **STRONG** STEAM SPECIALTIES

ANUM-METL Reg. Trade Mark



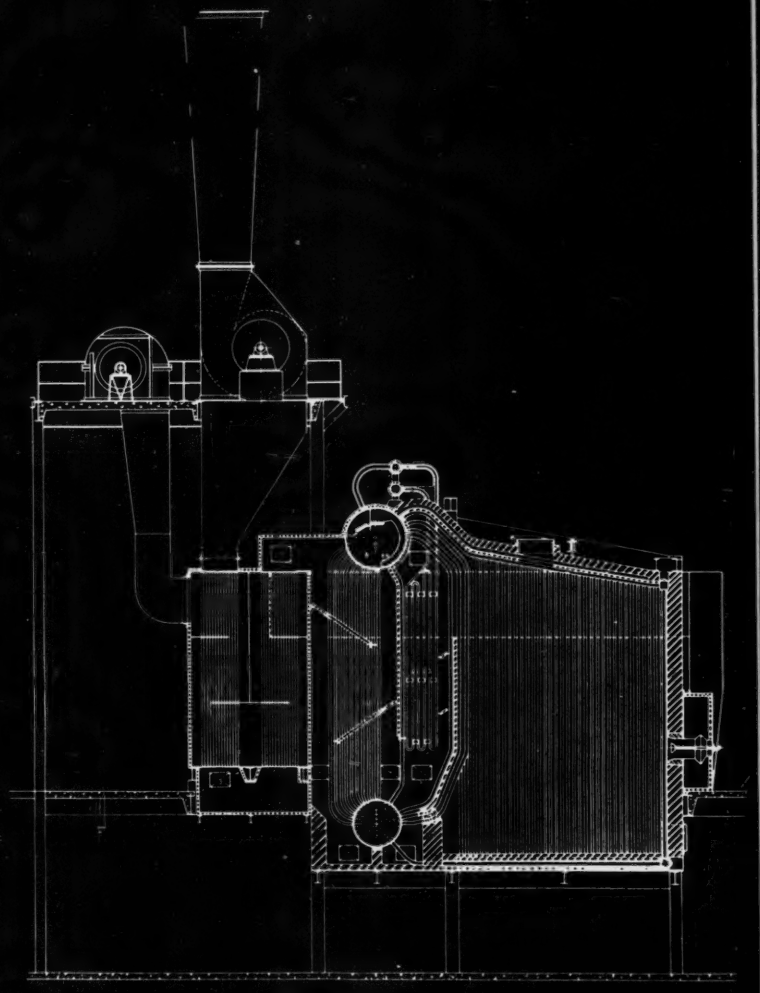
Blast Trap | Strainer | Large Capacity Trap

a Spri

for City of
Brownsville, Texas

BLACK & VEATCH
KANSAS CITY, MO.
Consulting Engineers

R. G. HALL
City Engineer



Another Springfield steam generating unit! Purchased for the City of Brownsville, Texas, southernmost municipal plant in the United States, it will produce 90,000 lbs. of steam per hour at 420 p.s.i. and 750° F. Designed for 82% efficiency with natural gas, the plant will operate in the open with housing structure to be added later when building construction conditions permit.

Springfield offers a wide range of modern steam generators for power, process, and heating service. Springfield service includes design, fabrication and erection of units complete with firing, draft, and control equipment—all taken on a "Single Responsibility" contract. We will be glad to submit a proposal covering your requirements. SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill., U. S. A.

SPRINGFIELD PRODUCTS

•

SECTIONAL HEADER BOILERS. Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher. Pressures to 900 lbs.

BENT TUBE STEAM GENERATORS. Modern designs for capacities from 20,000 lbs. and up.

STANDARD BOILERS, TYPE M. Twelve standard sizes to choose from. Low engineering costs. Simplified installation. Quicker delivery.

HEAVY DUTY WATER WALLS. Specialists in water cooled furnaces, including Springfield's divided furnace—center water wall (patented) construction.

SUPERHEATERS. Individually designed to meet the particular requirements of each installation.

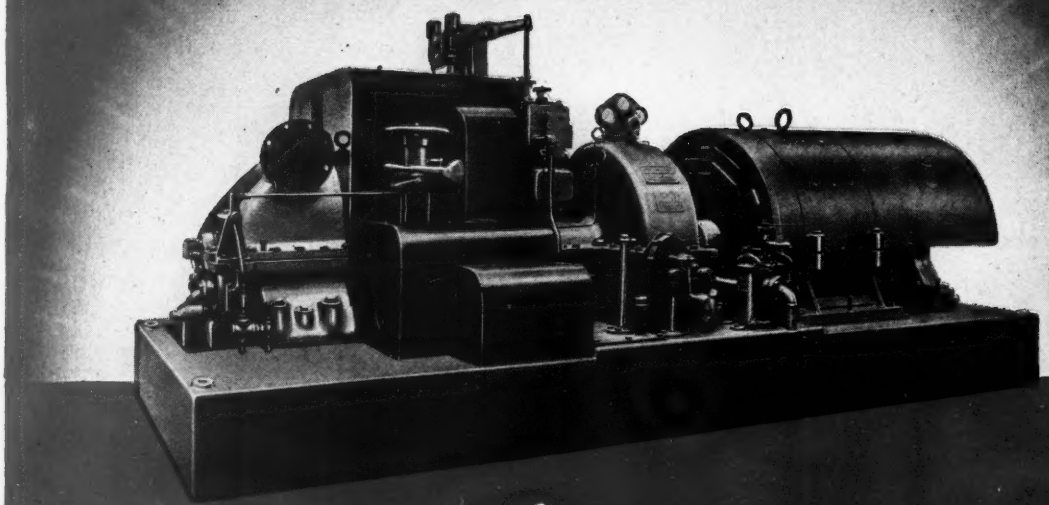
AIR PREHEATERS. Minimum maintenance required. Clean, modern design.

ECONOMIZERS. Built to meet individual requirements.

SPRINGFIELD BOILERS

SPRINGFIELD
STEAM GENERATING UNITS
ANY SIZE — ANY FUEL —
ANY PRESSURE

A COMPACT GENERATING UNIT *of* ADVANCED DESIGN



by DE LAVAL

The obviously neat design of this compact, self-contained, multi-stage geared turbine generating unit is typical of its highly refined design throughout.

For turbines of advanced design for all services consult De Laval engineers. Representatives are located in principal cities from coast to coast.

T-4

TURBINES · HELICAL GEARS · WORM GEAR SPEED REDUCERS · CENTRIFUGAL PUMPS · CENTRIFUGAL BLOWERS AND COMPRESSORS · IMO OIL PUMPS

DE LAVAL STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS, AUXILIARIES

1 **Fire-Tube Boilers**—Bulletin B-3 (13th Edition) covers the line of full-length and submerged fire-tube boilers made by this company. The boilers described range in capacity from 3 to 110 hp and may be manually or mechanically fired. Description covers; material, openings, handholes, fire door, fusible plug, standard equipment, additional equipment, etc. A full page table gives complete specifications for the units. The Brownell Co.

2 **Steam Generator**—This new bulletin 1214 outlines the features of a steam generating unit which is described as capable of developing full steam pressure in as little as 18 minutes. It describes how the unit comes completely assembled for easy installation with the boiler, oil burner, condensate return system and automatic control system mounted on a structural steel base. Orr & Sembower, Inc.

3 **Heat Transfer Apparatus**—A condensed and self-indexed Bulletin 1261 has just been issued by this company covering its line of heat transfer apparatus for chemical process work. The bulletin illustrates and concisely describes more than 20 different types of evaporators, heaters, coolers, condensers and heat exchangers for liquids, vapors and gases of all kinds. A two-page index table quickly shows suitable unit for handling specific fluids. The Griscom-Russell Co.

4 **Conversion Oil Burners**—Complete data on the company's line of industrial conversion burners is contained in Bulletin LD-4-6H. Theme of the bulletin centers around three features which are called the Flame Former, Iris Shutter and Tear Drop Valve. The catalog also illustrates the different types of boilers with which the burner may be used and presents two typical oil piping diagrams. York-Shipley, Inc.

5 **Steam Jet Air Ejectors**—This 8-page bulletin covers the company's line of steam jet air ejectors and shows various application for power plant, industrial and marine use. It contains engineering data, specifications, graphs and tables to help the engineer to select suitable equipment. Line drawings and photographs are used profusely in the bulletin to explain the various details of operation and construction. Condenser Service and Engineering Co., Inc.

6 **Small Scotch Marine Boilers**—Bulletin B-3050 is concerned with the new "Wee-Scot" Scotch marine boilers which have been designed to make available to industry a small boiler which retains all the prachical advantages of construction, economy, efficiency, installation and maintenance of power boilers of larger sizes. The bulletin contains four pages and tells about the construction, standard equipment, ratings and specifications of this unit. Line drawings and dimensioned drawings aid in the description. The Titusville Iron Works Co., Div. of Struthers Wells Corp.

7 **Controlling Boiler Feed Water**—Here is an 8-page bulletin 453 which describes the method of controlling boiler feed water for the new generating station of the New York Naval Shipyard. Photographs, charts showing load curve and steam demand, boiler meter and feed water charts, and tabular material of significant data assist in telling the story of this installation. Northern Equipment Co.

8 **Boiler, Fuel Burners, etc.**—Catalog GC-10 is a 12-page condensed catalog of regular products for stationary power plants. Each class of equipment is summarized and illustrated; pictures are included of typical units in each class group of boilers ranging from 1000 lb per hr up to 1,000,000 lb per hr capacity with steam pressures up 1800 psi and 955 F total steam temperature. Seven types of stokers are included as well as the bowl mill, horizontal and tangential burners for pulverized coal, superheaters, economizers and air heaters of both the plate and tubular type. Combustion Engineering Co., Inc.

9 **Condenser Injector**—This 4-page bulletin tells about the company's Wizard condenser injector which is described as instantly stopping tube leaks while the condenser continues to operate. It describes the construction, operation and installation of the unit and lists user of the injector. Line diagrams and photos increase the helpfulness of the booklet. Condenser Service & Engineering Co.

ELECTRICAL

10 **Fluorescent Lamps Guide**—Booklet A-4759 is a 24-page bulletin which covers basic principles and operating characteristics of fluorescent lamps and auxiliaries. The essential structure and operation of the mercury vapor electric discharge tube with its phosphor coating is shown diagrammatically and complete ratings are listed for important types of fluorescent lamps. The booklet also explains, with the aid of sketches and diagrams, the construction and function of ballasts, starters and lampholders. In the section on operating characteristics, mortality and replacement rate curves help to explain the factors affecting lamp life and maintenance. Westinghouse Electric Corp.

11 **Capacitor Motors for Jet Pumps**—This new Bulletin, GEA-4443, completely covers the company's capacitor-motors for jet pump drives. Features of construction of the motors are pointed out by means of cut-away illustrations with labeled parts which are referred to in the accompanying text. Illustrations of the integral parts of the motors are given. Information on how the motor operates, dimensioned line drawings and tables of dimensions add to the booklet's usefulness. General Electric, Schenectady.

12 **Synchronous Motors**—"Selection and Application of Synchronous Motors and Synchronous Motor Control," is the title of Pub. No. 1068 recently announced by this company. It's a 2-color, 24-page booklet with over 50 illustrations, of which more than half are diagrams or tables. A comprehensive treatment in simple language of operating characteristics, power factor, torques, flywheel effect, speeds, excitation, starting kva, braking, etc. Electric Machy. Mfg. Co.

13 **Low Speed Synchronous Motors**—Compactness, accessibility, good line power factor and other advantages of Elliott synchronous motors, operating at speeds of 450 rpm and below, are covered in new file size bulletin. Also gives detailed views of major construction features. Elliott Co.

14 **Motor Selection Guide**—Briefly, these are the data presented in this useful book: motor characteristics; construction; applications; engineering data; list prices; dimensions; motor control; gearmotors; and where to buy. The book has been carefully put together to give the utmost speed in use consistent with the problem of doing a complete and comprehensive job. Allis-Chalmers.

PUMPS, COMPRESSORS, FANS

15 **Rotary Blowers**—Bulletin 22-23-B-12 is a 24-page issue covering rotary positive blowers. In addition to numerous installation photographs, there are characteristic curves, cross sections, and exploded views to show the operating principle and construction features. Relief valves and other accessories are illustrated and described. Another feature of the booklet is a page of detailed specifications and a table of standard sizes covering gear diameters from 8 to 22 in. Roots-Connersville Blower Corp.

16 **Centrifugal Pump Control**—Reprinted in 28-page folder are the six useful articles on Centrifugal Pump Control written by Ignor Karassik and published in Power Plant Engineering. Deals with characteristics of centrifugal pumps, basic operations of pump controls, types used, etc. A valuable reference for all plant engineers. Worthington Pump and Machinery Corp.

17 **Horizontal Duplex Pumps**—Bulletin 230 covers the company's horizontal duplex piston pumps. It is a four page number and gives complete information including detailed description of the special mechanical features, metal specifications, sizes, capacities and dimensions. Automatic pumps and receivers are also illustrated and described in the same bulletin. Warren Steam Pump Co.

18 **Marine Jet Pumps**—Bulletin 46, Catalog 200A and 300A are attractively bound in a loose-leaf folder and describe, respectively, the company's jet pump booster, strainers and foot valves, and jet pumps for marine service. The jet pump booster is described as making accessible hard-to-get-at water supplies. The other bulletins tell all about the jet pumps, give capacity tables and curves and directions on the selection of the proper jet pump. They are well illustrated. Derbyshire Machine and Tool Co.

19 **Compressors**—This 20-page Bulletin 338 describes the company's horizontal compressor units. It describes in detail the various exclusive design features and emphasizes the advantages of horizontal compressor cylinders with V-angle power cylinders in the same vertical plane. The bulletin also includes a cross-section diagram showing the location of various components. Numerous other illustrations show parts and tabular material gives the specifications of the units. The Cooper-Bessemer Corp.

INSTRUMENTS

20 **Pyrometer Supplies Buyers' Guide**—Bulletin No. 100-1 is a 40-page catalog which presents clear and concise information for instrument men on how to order thermocouples, protecting tubes, thermocouple wire, lead wire, insulators, etc. The booklet also contains complete descriptions and prices on various types of standard thermocouples for applications in all industries. Dimensioned line drawings are used profusely throughout the book to aid in ordering. The Brown Instrument Co.

21 **Instruments**—This new 40-page, full color catalog describes industrial instruments and gages manufactured by this company. Included are complete descriptions and applications of pressure gages, vacuum gages, retard gages, compound gages, combination altitude pressure and thermometer gages and many others. The Electric Auto-Lite Co.

22 **Speed Indicators**—Bulletin 1815 tells about this company's chronometric tachometers. It gives the unit's speed ratings, method of operation, tells about the counting mechanisms and points out

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AUGUST, 1946

POWER PLANT ENGINEERING

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its accuracy. Cases and accessories are described and a table of specifications is presented. A list of prices for accessories to the speed indicators is a useful part of the bulletin. James G. Biddle Co.

METAL REPAIRS, WELDING

23 **Metal Repairing**—A 24-page Bulletin 103, which tells about this manufacturer's cold metal repair system and service. The process is described as a method of making cold repairs of cracked, broken or weakened machine parts or pressure vessels of cast or forged metal, in many cases where welding is impracticable or impossible. The various methods of making the repairs are outlined in the booklet and line drawings point out the features of repair. Typical jobs such as turbine casings, shear frames, crank shafts, diesel liners and diesel sections are illustrated and described. Technical aspects of the repairs are covered in one section. Metalock Casting Repair Service.

24 **"Difficult Welding" Electrodes**—This 16-page bulletin describes a new type of electrode designed to prevent underbead cracking in the welding of "difficult-to-weld" steels. The bulletin gives complete information on Type HTS, a lime-ferritic electrode which will weld successfully such materials as the high sulphur-free machining steels used in mold and die work, high carbon steels, cold rolled steels and cast iron. Tables give full data on the physical properties and chemical analysis of Type HTS deposit. Metal & Thermit Corp.

MAINTENANCE

25 **Building Maintenance Materials**—This 8-page bulletin on building maintenance is said by the manufacturer to be of interest to public utilities, federal and state agencies and municipalities. It describes the company's materials for maintenance of incinerators, sewage disposal plants, water works and power plants. The booklet is entirely composed of tabular material which lists the name of the material and opposite it the purpose which it serves in the various buildings. Stonhard Company.

26 **Portable Cleaning Units**—This 4-page catalog tells about an all-purpose portable cleaning unit for use in power plants and industrial establishments. The features of the unit are detailed and a list of specifications is given. A line drawing of the unit, on which the various parts are named, adds to the clarity of the description. U. S. Hoffman Machinery Corp.

PIPE, FITTINGS

27 **Strainers and Separators**—Bulletin 46-50 is a 16-page number which is entirely devoted to this company's line of strainers and separators. The bulletin gives dimensions and prices an Y type strainers, T type strainers, large pipeline Macomb type strainers for water or oil service, horizontal and vertical separators for steam, air or gas service as well as receiver separators for various installation conditions. The booklet is profusely illustrated with line drawings and photographs. American District Steam Co.

28 **Flexible Couplings**—This 36-page catalog covers the company's line of flexible couplings. General construction details and features are described and installation and operation data is covered thoroughly. Data regarding each of the several types of couplings includes dimensioned drawings and tabular material of engineering data. The back section of the booklet deals with special applications. American Flexible Coupling Co.

29 **Prefabricated Piping Systems**—Bulletin 546 describes a new and complete prefabricated underground and overhead conduit piping system, a continuous jacketed piping system, and a continuous extruded lead lined piping system. Line drawings in blueprint form are used to show the feature of these piping systems and dimensioned drawings accompany a tabulated list of dimensions. There are 6 pages in the booklet. E. B. Kaiser Co.

30 **Guide for Pipe Users**—A new 56-page catalog, featuring application of lightweight pipe in diameters from 4 to 30 in., has just been issued by the Naylor Pipe Co. Installation photos show application of Naylor Lockseam Spiralweld pipe in fields in which light-weight pipe is used to advantage. Along with valuable data on pipe structure are sections on precision fabrication and pipe connections including an entirely new type of coupling which saves time and labor for users.

31 **Packless Expansion Joints**—This 8-page bulletin tells all about the five types of packless expansion joints which have just been announced by this manufacturer; they range in size from 25 psi max. to 1000 psi maximum. Dimensioned drawings, tables of dimensions, and lists of specifications are included for each of the various types. An explanation of the features of the new design is presented and the bulletin tells about the special types which can be made to order. Magnilastic Division, Gook Electric Co.

32 **Try-Cocks Bulletin**—Bulletin WG-1815 is a 4-page piece which completely describes the company's Sealtite try-cocks. Two types are shown—weight-operated and lever-operated; a cut-away view shows the interior construction of the unit. A quotation from the ASME power boiler code is presented to illustrate the need for these devices and their operation is outlined in detail. Dimensions, prices and parts lists are given on the last page of the folder. Yarnall-Waring Co.

33 **Safety, Relief Valves**—Twenty basic designs of improved safety and relief valves are described and illustrated in a new condensed Bulletin 40. The valves described have been custom-built to users' specifications—users in the chemical, petroleum, marine and equipment manufacturing fields assisted in their design. The bulletin gives the essential construction and operation specifications briefly. Valve designs described include high pressure types, liquid relief, diaphragm relief, full venturi and semi venturi types of safety, relief, safety-relief and pop valves. Farris Engineering Co.

TOOLS

34 **Tools, Metal Etchers, Chucks**—This 24-page catalog, designated as Form MTC-1245, covers several items in the company's line. Included are pneumatic drills, pneumatic screwdrivers, file and die grinders, riveting hammer, pneumatic tool accessories, dust collectors, live centers, balancing ways, metal etchers, demagnetizers, etc. The booklet is well illustrated and contains specifications and materials listing. Ideal Industries, Inc.

35 **Pipe and Bolt Tools**—Form CC 4-24-46 is a 4-page price list and bulletin telling about the company's line of pipe and bolt machines, die heads, ratchets and cutting oil. Brief descriptions, illustrations and prices of each of the items are conveniently grouped together for easy reference. Beaver Pipe Tools.

TRANSMISSION, DRIVES

36 **Magnetic Drives**—A data booklet that starts out with a detailed description of the method of regulating the output of mechanical draft fans with these magnetic drives. Next, a section is devoted to a report on how the drive itself works. Both sections are illustrated and performance curves are given. Parts are illustrated and line drawings show how the drive is adaptable to various requirements. Electric Machinery Mfg. Co.

37 **Reconversion Inventory of V-Belt Drives**—Handy check list for each machine shows: 1. Present condition of drive; 2. Condition of belt; 3. Condition of sheaves; 4. Drive engineering; 5. Belt engineering. Offers practical tips on correcting scuffing, slip burn, oil swelling and abrasion. Allis-Chalmers Mfg. Co.

38 **Transmission Belting**—A new catalog section on transmission belting has been published by the B. F. Goodrich Co. Featured is Highflex, which was the first successful square edge, foldless hard duck transmission belt when it was introduced in 1925. Details of the manufacturing and testing program for each foot of this belt are given, as well as its advantages in service.

39 **Conveyor Idlers**—Bulletin 463 covers the complete line of this company's conveyor idlers. Photographs, tables, charts, diagrams, cutaway views are used profusely to illustrate and describe the items. The first section of the book is devoted to the proper selection of idlers. Then follows a large two-page cutaway illustration showing details of construction. Then comes a section with a description of the complete line of standard idlers; then a section on special application idlers, Chain Belt Co.

MISCELLANEOUS

40 **High-Heat Resistant Coating**—This new bulletin tells about Thur-Ma-Lox, a material which protects metal surfaces in power and process equipment against temperature damage from sub-zero to red hot. The bulletin lists the story of these coatings, what they do and how they are applied. Typical applications for two types of the coating are given. The Dampney Company of America.

41 **Chemical Proportioning Equipment**—Bulletin 1714 covers chemical proportioning equipment for seagoing service. There are four pages in the bulletin. Tank specifications and tank materials are listed and the two units—for high or low pressure—are described fully and are illustrated. Tabular material assists in the description. Proportioneers, Inc.

42 **Fuel Oil Treatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge," has just been issued. Advantages of using the treatment such as stepping up efficiency and reducing operating costs are explained. A list of dosages and applications are also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

43 **Condensate Oil Removal**—A newly issued bulletin deals with the advantages of pre-formed floc type of condensate oil removal filter. Details of the operation of rake agitator and rotary surface washer units are also given. The Permutit Co.

44 **Acidity-Alkalinity Indicator**—This 8-page bulletin reviews the necessity for laboratory control of acidity and alkalinity and the history of the use of methyl-orange in the laboratory. It then goes on to tell about the methyl-purple indicator which the company has just developed and recites its advantages over the methyl-orange. List prices and tabular listing of advantages are given and a free trial sample is offered. Fleisher Chemical Co.

45 **Diesel Tractor**—MS-290A is an illustrated 24-page catalog which tells about the company's new HD-7 Diesel tractor which can be used for many applications around the power plant—coal packing, carrying heavy loads around the plant yards, general construction, leveling, etc. Given prominent display in the catalog are facts about the General Motors 2-cycle engine, the unit injector, transmission construction and the sealed truck wheels. Allis-Chalmers Mfg. Co.

46 **The ABC's of Modern Plastics**—Here is a beautifully prepared little booklet (36 pages) which provides a brief outline of the origin, preparation and uses of plastics and of their importance in modern living. Complex technical processes are described in terms of everyday living and further explained in colorful charts and lively illustrations. Some of the subjects discussed are thermosetting and thermoplastic materials; molding and extrusion; all types of laminating; plywood molding and wood bonding; impregnating and sealing. The booklet also shows many possible future uses of these materials. Bakelite Corp.

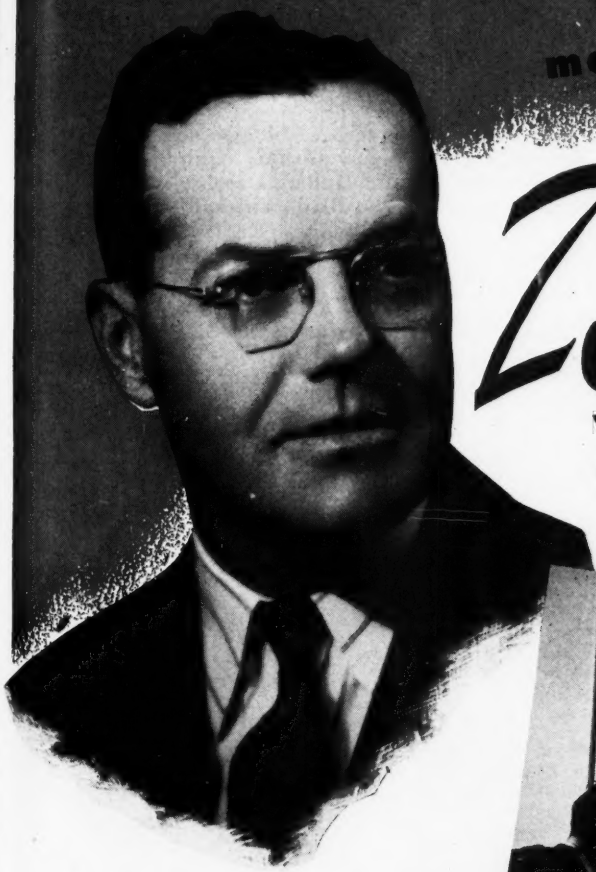
47 **Catalog of American Standards**—This complete list of American Standards Assn., standards should serve as a valuable reference material to engineers, manufacturers and sales organizations. It presents a price list of American standards; it covers civil engineering and construction; mechanical engineering; electrical engineering; automotive; transportation; ferrous metals and metallurgy; non-ferrous metals and metallurgy; rubber; chemicals; textiles; mining; wood; pulp and paper; miscellaneous; and commercial standards. There are 24 pages. American Standards Assn.

48 **Grinding Wheels**—This 32-page booklet covers grinding wheels and other abrasive products of this manufacturer. It presents suggested specifications, list prices, shows portable grinder equipment, tells about the new "Resinoid" foundry wheel and disc grinders, and uses photographs, line drawings and tabular material in an effective manner. The booklet is printed in three colors. Norton Company.

49 **Packings**—A new 64-page catalog containing complete descriptions with illustrations of all the various styles and types of mechanical packings in the company's line has been issued. The manufacturer points out that it is the most complete reference on packings it has ever issued. There are five pages of charts showing the type of service each packing is recommended for. The catalog is attractively printed in two colors, contains a short history of the manufacturer and includes illustrations of its five plants. Tabular material adds to the book's usefulness. Raybestos-Manhattan.

50 **A Story of Sound**—This Bulletin No. 120, "A Story of Sound," contains 36 pages and tells, in simple language, of the intricate phenomena of sound. It also

(Continued on page 168)



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OVER a quarter-million water treatment service jobs in the United States alone sounds like a huge order. Yet, for best boiler performance and lowest maintenance and repair costs, *every* steam generating unit needs the advantages of thorough, made-to-order water treatment . . . No two plants have precisely the same water and operating conditions, so individualized water treatment is the obvious answer wherever steam generation costs are a factor.

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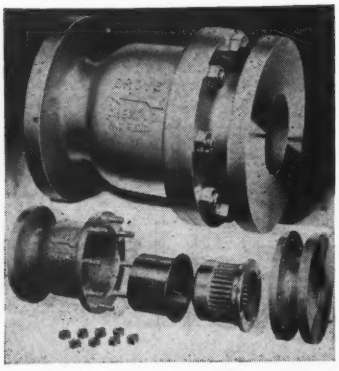
THE SCIENTIFIC WATER TREATMENT SYSTEM FOR ALL INDUSTRY

New Equipment News

The new equipment items in this section are identified by letters which precede the headings. When further information is desired regarding any of this equipment write this corresponding letter on the coupon in the Helpful Bulletins section, cut it out and send it to Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Ill.

A New Check Valves. This newly developed check valve has been announced by Grove Regulator Co. Operation of the valve is effected by a synthetic rubber tube, stretched over a slotted, cup-shaped metal core, which expands to open and contracts to close. It is pointed out that due to the fact that this tube closes instantly on balanced flow, prior to the commencement of back flow, there is never any tendency to establish pressure impulses, shock or water hammer through the flow line.



The flexible tube possesses a uniform and constant spring rate which avoids inertia being set up to cause operation beyond flow requirements. Because of its self-compensating and wear resistant factors, the manufacturer says, this unit is parcticularly suited for handling even the most highly corrosive and erosive air, gases or liquids.

B Waterproof Coating for Porous Walls. The new coating devised by Truscon Laboratories and recently put on the market under the name of Tite-Wall is described as economical, easily applied, as covering in one coat and preventing rain from penetrating cinder and concrete block walls.

Tite-Wall may be used on practically any rough, porous surface but especially on concrete and on cinder block. It is said to be a "natural" for cinder block, for basement walls or for outside walls. Tite-Wall is mixed with water, which makes it economical; it paints out like an oil paint, even on rough surfaces.

When applied in 2 coats it has remarkable water-resisting properties. Exterior block walls which leak like a sieve at every rain are successfully waterproofed with two coats of Tite-Wall. Even in damp basements a considerable reduction of dampness and seepage is noticed where 2 coats of Tite-Wall are applied to previously wet inside cement or block walls.

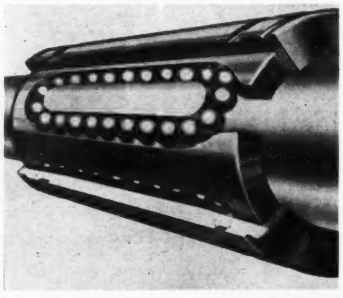
C Ball Bushing for Linear Motion. There are two fundamental mechanical motions — rotary and linear. Bearings for linear motion, until now, were just plain sliding bearings. The recently developed Ball Bushing for linear motions is a contribution of importance.

Thomson Industries, Inc., announces the standardization and production of their round shaft type Ball Bushing. Production of this new anti-friction bearing now brings to the designer a bearing for his linear motions that possesses all the advantages and economies that ball bearings impart to rotary motions.

In addition to the reduction of wear, friction and maintenance afforded by all types of anti-friction bearings, the availability of Ball Bushings offers the engineer a solution to two troublesome problems inherent to plain sliding linear bearings.

The oil film, over the exposed surface of the shaft upon which the plain bearing's operation depends, deteriorates due to oxidation and becomes gummy and grit laden. Elimination of the obvious consequences of this condition is a major contribution to modern mechanism design.

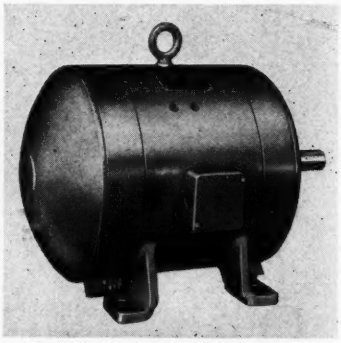
Plain linear bearings require a large length to diameter ratio to prevent cocking and binding. Free rolling Ball Bushings sharply reduce this dimension requirement and permit startling design economies.



They also offer the other advantages of ball bearings, such as savings from the use of smaller drive motors, gears, linkages, etc.; operating economies due to reduced load; longer life; increased reliability; less servicing; higher operating speeds and sustained precision.

Standard Ball Bushing sizes vary from ¼ in. shaft size to 4 in. Sizes from ¼ in. to 1 in. vary in ⅛ in. steps; from 1 in. to 3 in. in ¼ in. steps and from 3 in. to 4 in. in ½ in. steps. Production of some of the smaller sizes is now under way. Volume production of the remaining sizes will be started as rapidly as the tooling for each can be completed.

D Motor and Generator Line. A wide range of direct current motors and generators is now in large scale production by Bardco Mfg. and Sales Co. The motors range in size from 2 to 75 kw. Four generators from 2 to 60 kw. Four frame sizes have been standardized upon in the interest of economical production. Class B insulation, of glass insulated wire and formed mica slot insulations, permits ratings of 60 C temperature rise. High quality Duro paper insulation, cellulose acetate rayon tape and synthetic enamel wire are used in insulating class A machines. These machines will not exceed 40 C rise in open and drip-proof frames. All field windings are impregnated with insulating varnish and baked, after assembly on pole pieces. Bronze brush boxes prevent corrosion, as does the final painting and rust-proof treatment given the complete generators or motors.



Field rings are rolled steel with welded feet. Lighter weight for same output is achieved by this method in comparison with cast-steel field rings. All welded parts are stress-relieved by heat treatment.

Motors are available with series, shunt or compound windings at 115 or 230 v and at either 1750, 1450 or 1150 rpm. The generators are available either shunt or compound wound, at 125 or 250 v and with the same speed variations as the motors. Drip proof covers for marine service are optional equipment.

AREA OF LEAK	AIR		STEAM		WATER	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet	Pounds wasted per month at 160 lb. pressure	Total cost of waste per month 65c per 1000 lb.	Gallons wasted per month at 60 lb. pressure	Total cost of waste per month 16c per 1000 gallons
1/2"	13,468,000	$1,481.44	1,219,280	$792.53	1,524,100	$243.86
3/8"	7,558,500	831.44	684,290	444.79	855,360	136.86
1/4"	3,366,990	370.37	304,820	198.13	381,020	60.96
1/8"	824,570	90.70	74,650	48.52	93,310	14.93
1/16"	213,000	23.43	19,280	12.53	24,110	3.86
1/32"	52,910	5.82	4,790	3.11	5,990	.96

What does it cost you each month

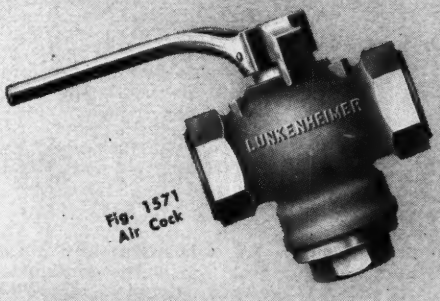
... for air, steam, water, you never use?

Maybe you've never checked the actual cost of valve leakage. If you haven't, you'll doubtless be startled at these figures.

A single valve leak the size of a pinhead can waste enough air in a month to approximate the cost of a new valve. Steam leaks... water leaks... also take a heavy toll if neglected... not to mention the wastage of such a critical item as fuel.

Where Lunkenheimer Valves are given ordinary care, such losses are held to an absolute minimum. These quality-built valves are designed to give extra long service with the lowest possible outlay of time, labor, and money, for maintenance.

Enlarged copies of the above chart for posting in your plant are available on request. Also available are the services of your nearby Lunkenheimer Distributor, who is fully equipped to assist in solution of your operating or maintenance problems.



ESTABLISHED 1862

THE LUNKENHEIMER CO.

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LUNKENHEIMER VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

E Dial Type Thermometer. The Bacharach Industrial Instrument Co. is now producing an all-metal, dial-type thermometer for indicating temperatures from 100 to 950 F. It is provided with a slip-on

handle which protects the operator's hand when the instrument is in portable use. The handle can be easily detached when the instrument is to be used as a permanently-mounted indicating thermometer.

Features of this instrument include: Quick response to temperature change; all-metal construction which gives maximum protection against vibration, shock, and rough handling; precision bi-metallic temperature element has no pivots, mechanical linkages, or gears and is stated to provide sustained accuracy within 1 per cent of scale range; designed to withstand momentary over-scale temperatures within 10 per cent of scale range.

Made with corrosion-proof stainless steel stem 3/16 in. OD and 5 in. free length, with only 2 in. immersion required to obtain accurate readings. Also available with 3/8 in. OD stem having 9 in. free length.

F Corrosion Resistant Fan. A newly designed corrosion resistant fan of monel metal for damp or corrosive vapors, or of cold rolled steel for ordinary exhaust ventilation and cooling is now available from the Moore Co. Made in 3 to 5 ft diameters with features that give increased efficiency the fan is of the axial-flow ventilating type. A special high slip, slow speed, direct drive motor, equipped with permanently greased and sealed ball bearings makes it possible to mount the fan in any position. The motor is an

18 pole, 375 rpm, 220 v, single phase or 220-440 v, three phase, with an input of 700 w. The motor is internally cooled by circulating air within the hub of the fan without drawing in outside air that might be contaminated.

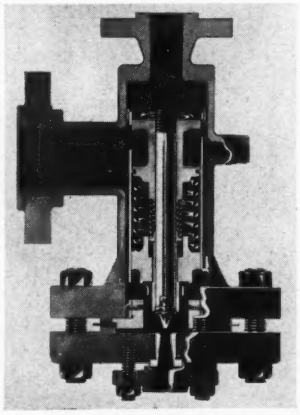
Guide vanes on the inlet side of the fan reduce the tendency of the air to corkscrew with the rotation of the blades. The blade tips revolve within a ring that reduces tip losses. The large hub eliminates that portion of the blade that has a low peripheral speed and thereby voids the possibility of a backflow of air through the center of the fan.

G Recirculating Valve. The Hammel-Dahl Co. offers a recirculating valve to eliminate centrifugal pump failures resulting from insufficient flow of fluid through the pump, causing overheating and destruction of the pump.

Insufficient fluid flow arises from failure of fixed recirculating orifices, failure of prime mover to drive the pump at sufficiently high speed or to restrictions in the discharge piping.

This system consists of an automatic recirculating valve operated from the fluid flow and designed to by-pass the minimum quantity of fluid required to eliminate pump overheating. As the quantity of fluid passing through the pump increases, the by-pass quantity is automatically throttled and is reduced to zero when the output of the pump is sufficient to prevent pump failure.

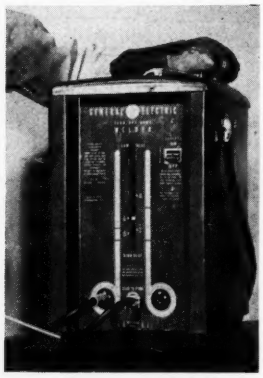
The valve may be installed in existing pump piping merely by removing any convenient elbow in the discharge piping upstream of all checks and stops. With little or no flow through the pump, the by-pass is wide open, recirculating enough fluid to prevent overheating.



If the discharge rate starts to increase, the plug in the automatic recirculating valve approaches its seat, decreasing the quantity of fluid recirculated. When the flow through the discharge line is of sufficient magnitude to prevent overheating of the pump, the by-pass valve closes tight, allowing all of the pump output to pass through the discharge line. On decreasing flows, the above cycle is reversed, thus providing full pump protection at all times with maximum efficiency.

H Small Arc Welder. A new a-c small arc welder especially designed for operation on single-phase lines of limited capacity supplying rural areas and small communities has been announced by the General Electric Co. Conforming to NEMA Standards and Edison Electric Institute and Rural Electrification Administration requirements for farm welders, it is designed for the greatest possible protection for the operator and the equipment itself.

The new welder is furnished in two ratings, 130 and 180 amperes, either with or without capacitors. Small in size and light in weight, it occupies little floor space and can be easily moved about. It has two plug-in connections for the electrode cable, one for use with 1/16 in. or 5/64 in. electrodes and one for 3/32 in., ⅛ in.,



and, in the larger rating, 5/32 in. electrodes.

A welding current scale located on the front of the welder is calibrated in electrode sizes rather than in amperes. Current adjustments are made by means of a hand crank which provides an infinite number of settings to accommodate the size electrode being used. An electrode gage consisting of a series of calibrated notches on the bottom edge of the front panel makes possible quick identification of electrode size.

Designed into the new welder are several safety features which protect both the operator and equipment. The welder is constructed to use the lowest possible welding voltage consistent with good welding practice, and is enclosed in an electrically grounded metal case. In addition, it is protected against overload by a built-in circuit breaker.

Included with the welder are 15 ft of electrode cable complete with plug connector and fully-insulated electrode holder, 10 ft of ground cable connected to the welder with ground clamp attached, 10 ft of primary cable with a three-prong plug attached, and a wall receptacle.

Furnished in the accessory package is an instruction manual, a hand shield, slag hammer, scratch brush, pair of welder's gloves, Strike-Easy crayon, four pounds of Type W-25 all-purpose mild steel electrodes and one pound of Type W-93 hard surfacing electrodes.

J Cleaner for Plastics. The plastic windshields on airplanes presented quite a different problem for cleaning than the ordinary automobile windshield and other glass surfaces. Airplane operators soon discovered that they could not use the ordinary glass cleaning solution on their plastic windshields because they had a tendency to damage the surface. It therefore was necessary to develop a formula which

WORTH REMEMBERING!...

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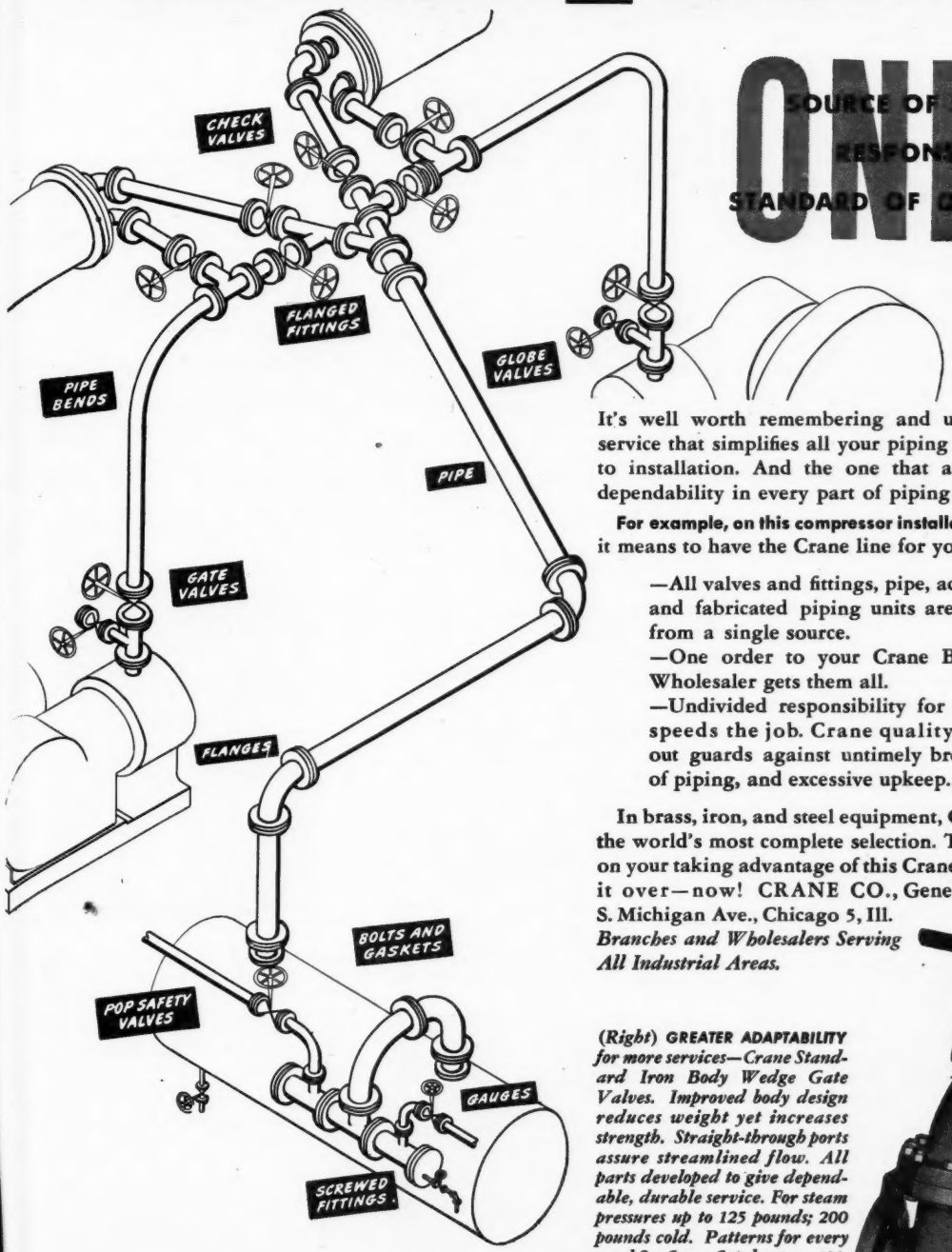

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(*Right*) **GREATER ADAPTABILITY** *for more services—Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight yet increases strength. Straight-through ports assure streamlined flow. All parts developed to give dependable, durable service. For steam pressures up to 125 pounds; 200 pounds cold. Patterns for every need.* *See Crane Catalog, page 101.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
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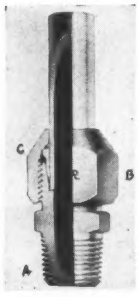
FOR EVERY PIPING SYSTEM

would do a good job of cleaning without attacking the plastic surface. Under the name of Glit the Kano Laboratories have announced a special concentrated cleaner for both plastic and glass surfaces. This cleaner has an extremely low surface tension and high detergent qualities without the tendency to dissolve the surface of the sheet plastic or molded plastic.

Glit is recommended for use also on auto windshields, neon lights, fluorescent lights, window reflectors, show windows, desk tops, electric lamps. In fact, it quickly cuts through the grease and film and bug stains on any glazed, plastic or polished surface. It comes in a concentrated form to which three to seven parts of clean water are added, depending upon temperature.

K Flareless Fitting. The Parker Appliance Co. announces the development of a new fitting for use in joining all types of metal tubing, including ¼ hard stainless steel, in hydraulic and fluid-conveying systems. Eliminating the need for special flaring and assembly tools, brazing or soldering, the new fitting incorporates a steel ferrule which, when body and enclosing nut are tightened up, acts to cut a shoulder in the tubing itself, thus providing a strong, tight sealing grasp for the assembly. The new fitting is expected to be particularly useful in high-pressure applications and in installations where thick wall tubing is used.



In the accompanying cross section, the arrangement which produces the cutting action can be seen. When the body "A" and the nut "B" are tightened, the confined ferrule "C" is forced forward. The cone angle of the body contacts the ferrule, and directs its sharp forward edge downward. The reduction of section in the leading edge of the ferrule permits deflection of the extremity so as to afford good camming contact for the bite into the tube. Further tightening at specified torques forces the ferrule into the tube, casting up a shoulder to resist pull-out when pressure is applied in the system. The actual fluid seal is also accomplished by the compression of the ferrule, which has a negligible effect on the internal diameter of the tubing being fitted.

To be available initially in ¼ in.—1 in. OD tube sizes, in all conventional shapes and materials, the fittings will be threaded identically in size and pitch with the correspondng flared fitting.

L 5-Ampere Variacs. A new series of Variac autotransformers, designated as Type V-5, is announced by the General Radio Co., to replace the Type 200-C models. Intended for the manual control of a-c voltage, these new Variacs incorporate improvements in convenience, utility, reliability, appearance, and value.

Through the use of grain-oriented strip cores, both iron and copper are reduced for the same power rating. This weight saving is furthered by

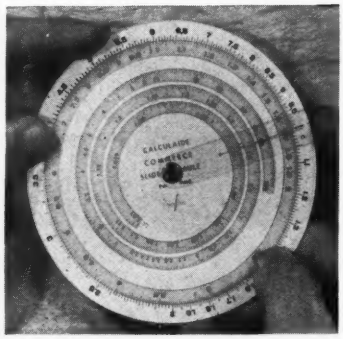
aluminum structural parts instead of steel and zinc. The over-all reduction in weight yields 25 per cent more kva per pound than previous models.

The new unit brush is used, which can be changed without tools. Proper brush pressure is assured by an accurate coil spring, and brush extension is limited to prevent short-circuit damage through contact of the brush holder with the winding.

Rated output current for 115-v models is 5 amp; maximum current is 7.5 amp. Voltage output can be varied from 0 to 17 per cent above line voltage. Volt-ampere rating is 0.862 kva. 230-v models will handle 0.575 kva with current ratings of 2 amp, rated, and 2.5 amp maximum.

M Circular Slide Rule. The precision of a 12-in. slide rule is combined with pocket-size convenience in the simplified Calculaide Commerce slide rule developed by American Hydromath Co. Only 4½ in. in diameter, this new type of circular slide rule incorporates many advantages over both traditional slide rules and conventional circular slide rules.

Accuracy is enhanced by locating the most-used scales close to the edge, so that each is actually 12½ in. long. Easy reading is assured by use of contrasting colors on scales. Also in problems of proportion or the like, such contrasting colors aid greatly in remembering which variable each scale relates to. Graduations are reproduced on facing surfaces, protected with a thin plastic lamination, so that parallax error is virtually eliminated.



Precision centering and durable construction eliminate need for centering adjustment. A further feature, which makes the instrument of greater usefulness to a wider group of users, is elimination of the seldom-used scales found on many slide rules. The Calculaide slide rule carries the usual C and D scales, plus a log-log scale ranging from 1.01 to 100, which appears as an inner spiral of almost three turns and which is conveniently arranged for computing in one setting compound interest problems, both for annual and quarterly compounding. Numerous engineering problems, such as in the field of gas compression and expansion, also may be easily and accurately solved on this scale.

The new Calculaide Commerce slide rule is precision manufactured from tough, non-warping, non-inflammable plastic which is unaffected by moisture, perspiration, or ink. It can be easily cleaned with a damp cloth. Clear, concise directions are printed on the back. It is furnished in an attractive leather case which easily slips into the pocket.

N 20-kva Mobile Brazer. Designed for general brazing service, a new 20-kva portable brazer with water-cooled tongs is announced by the Westinghouse Electric Corp.

Enclosed in a circular steel housing, the entire unit is self-contained,

having a contactor for energizing or de-energizing the brazing circuit, an adjustable heat brazing transformer, and a water-cooling system for the tong cooling water. Diameter is kept small (24 in.) so that it can be lowered through hatches, watertight doors, and manholes. A clamp type entrance bushing is provided on rear of the brazer for the incoming primary cable. The unit requires only connection to a 220- or 440-v power source.

The control panel, built into the front of the brazer, contains a control switch, outlets for brazing cables, receptacle for foot switch pilot cable, and voltage tap changing plug. The foot switch, which controls the length of time during which current is applied, is provided with a length of pilot cable so that it may be placed at the operating station.

The brazing transformer is air cooled by induced draft. Air is drawn into the brazer through openings under the top cover, is pulled through the transformer and expelled through screened openings in the bottom of the brazer case.

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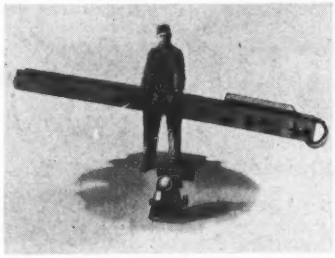
FOSTER WHEELER

New Lightweight Conveyor. A new lightweight portable conveyor for industry, called the Tote-All Zephyr, has been announced by Material Movement Industries (formerly Coaltoter Conveyor Co.). According to the manufacturer, this conveyor brings a new meaning to the word portability in the field of power conveying. The 12 ft model weighs only 135 lb (without motor). It is made of special alloy steel and is corrosion and abrasion



resistant. At the present time, two lengths are available—12 ft and 16 ft. Both models have an 8 in. belt. Power is furnished by a gasoline engine which is mounted above conveyor, out of the way of dust, dirt and spillage. Engine mounting is adjustable to keep engine level at all conveyor positions. Conveyor may also be furnished with an electric motor for use when electricity is available or it may be purchased without power unit if desired.

Easily carried by one man from one job to another, the Tote-All Zephyr may be used for conveying many types of bulk products such as sand, salt, coal, gravel, fertilizer, etc.

Electrode for Cast Iron Welding. An important advance in cast iron welding has been the development of the Ni-Rod electrode by The International Nickel Co.'s Bayonne Research Laboratory in cooperation with the Company's Bayonne Works.

Cast iron is brittle and heat-sensitive. In the past, welding it has meant a series of compromises in the properties of the finished weld. For instance, some weld deposits would be easy to machine but low in strength and subject to cracks and porosity. Others were strong, but hard to machine. Often, particularly in stressed castings, deposits would tend to spall out, or flake off, in service due to poor fusion with the parent metal or excessive cracking at or just outside the fusion line.

Ni-Rod was introduced a few months ago and has already been widely used for all types of cast iron welding. It minimizes the troubles that have marked cast iron welding heretofore. Its deposit is both strong and machinable. Being nickel, it is actually much stronger than cast iron itself. Fusion of the deposit and the parent metal is so thorough that it is virtually impossible to knock loose a weld or overlay made with it.

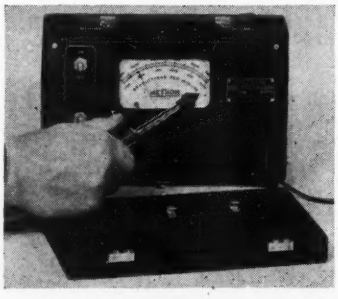
Welders have found its arc to be stable in all positions, without a trace of flutter. The deposit washes evenly up against the sides of the joint. It doesn't undercut or leave narrow grooves to trap flakes of slag that would weaken the weld as subsequent passes are made. This, in combination with the chemical nature of the flux itself makes it very easy to remove the slag from a Ni-Rod bead.

Overspeed Tachometer. Now available for overspeed testing of turbines, generators, and motors is the type 48A tachometer. It is announced by Metron Instrument Co. This portable tachometer has two ranges for testing either 1800 rpm or 3600 rpm machines. The 1800 rpm range is from 1700 to 2200 rpm and the 3600 rpm range is from 3400 to 4400 rpm. Reports state that the accuracy on both ranges is one quarter of one per cent.

The instrument is especially designed for testing over-speed protection on turbo-electric generators and similar applications. There are only 2 controls; an on-off switch and a high-low range switch.

Operating power is obtained from an ac source of 105 to 125 v 60 cycles. The head, which is very small and requires only ¼ in. oz. to rotate, is a positive acting switch connected through a reactance in a bridge circuit so that the meter indication in the bridge circuit is directly proportional to the number of switching operations per minute of the head. Neither the balance nor response of the bridge circuit, is affected by line voltage fluctuations between 105 and 125 v since the instrument has a built-in voltage stabilizer.

The manufacturer points out that no warm-up period is required and sustained accuracy is assured because the instrument has excellent stability against time, use, temperature, and humidity effects. It is impossible to damage the instrument by selection of incorrect ranges or by rotating the head spindle at excessive speeds. The instrument is supplied complete in an attractive carrying case with in-



strument card, neoprene contact tips, and shaft extension for reaching recessed shafts. This tachometer is also available with other ranges for specialized applications.

Coating for Protecting Refractory Walls. The Gamlen Chemical Co. has just introduced Firemaster refractory coating which, after being brushed or sprayed on to furnace refractory walls, dries into a seamless monolithic lining that is practically impervious to the effects of slag and other products of combustion.

This new coating fuses, in the presence of heat at the regular furnace operating temperatures, into a continuous, glass-like substance of high strength and heat-reflecting properties. Its makers state that this seamless lining prevents infiltration of gases into refractory walls, reduces spalling, and minimizes accumulation of slag, therefore greatly reducing brick work maintenance. It is also stated that the coating improves combustion in two ways—by sealing air leaks, thus preventing heat loss through the walls, and by reflecting a better percentage of the heat back into the furnace.

Firemaster is made in a variety of grades, vitrifying as low as 1000 F, or as high as 3000 F, for all types of furnaces, burning any type of fuel. Its use requires no shutdown other than the time taken to apply the coating. The furnace is fired immediately after application, and operated at once at normal temperatures.

Safety Airgun. A great improvement in air guns has been announced by the makers of Guardair. The Guardair, by its patented design, will not subject the operator to a blast of blinding particles that might prove fatal to vision.

An ingenious airguard, located

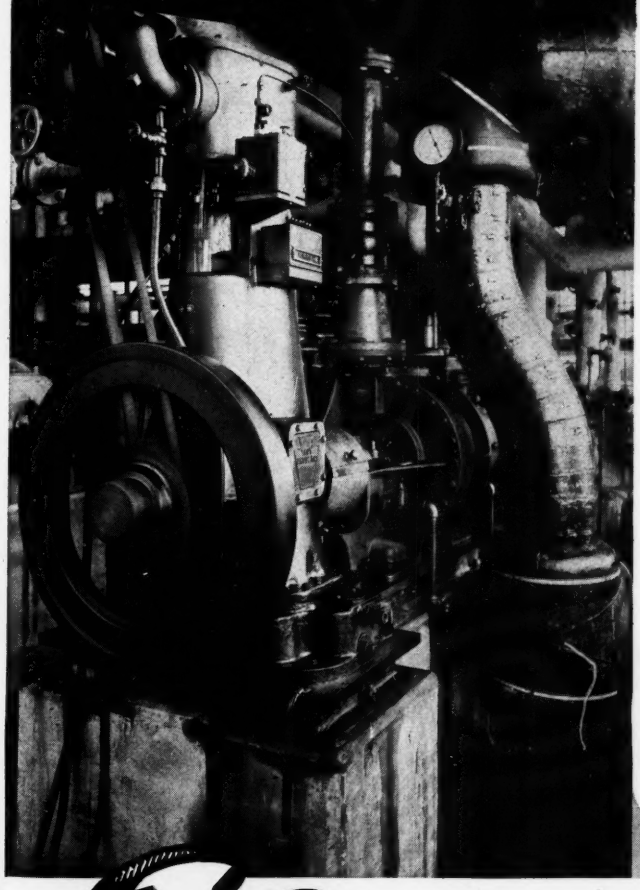
above the nozzle of the air gun, provides a safety umbrella of air. Particles ejected by the nozzle are instantly removed from the work by a feather-action thumb button. Instead of chips, metal powder, sawdust, oil or a host of other materials ricocheting into the operator's eyes, these minute particles are arrested by the invisible ring of air and plummeted downward. It is made by Algonquin Parts, Inc.

Torque Wrenches. The P. A. Sturtevant Co. announces the addition of four new models to its line of torque wrenches. They are as follows: Model S200 having capacity 0 to 200 ft lb, calibrated in 5 ft lb steps; Model S300 having capacity 0 to 300 ft lb, calibrated in 10 ft lb steps; Model S2400-I having capacity 0 to 2400 in. lb, calibrated in 50 in. lb steps; Model S3600-I having capacity 0 to 3600 in. lb, calibrated in 100 in. lb steps.

These four models are equipped with ¾ in. drive squares. Up to now, the Sturtevant Sensory line has been furnished in 25, 50, 100 foot pound and corresponding inch pound capacities.

These wrenches permit the measurement of pre-set torque by sight, sound and feel. When the pre-set torque has been reached the sensory mechanism sounds a loud and distinct click and imparts a definite strong impulse to the hand. The applied torque can also be read on the dials which are readable from all working angles.

By-Product POWER drives this BLOWER



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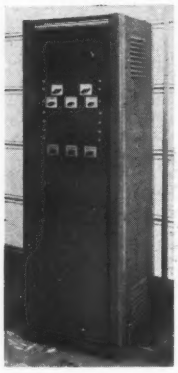
STEAM ENGINES • GENERATING SETS • GENERATORS

U Control for Grinding Mills. The Gai-Tronic Corp. announces an electronic, mill feed control known as the Gai-Trol. The control is said to improve the efficiency, output and performance of tube, ball, bowl and other types of grinding mills. In power plants employing pulverized coal for direct firing, its use results in an increase in boiler efficiency. It is described as making possible operation of the mill at peak efficiency, increased production, controlled fineness of grind or otherwise better coordination of the grining operation with production requirements.

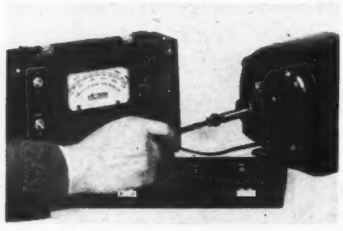


The equipment consists essentially of a load detector external to the mill and connected directly to the electronic equipment which is contained in a 66 in. high floor-mounted, self-supporting steel cabinet. A circuit from the electronic equipment in this cabinet supplies a variable speed, direct current, feeder drive motor.

The circuit between the load detector and the feeder is direct and entirely electronic. No relays, moving parts or mechanical speed change equipment is involved. Response is instantaneous and direct. The speed of the feed motor is controlled precisely and continuously throughout a stepless range and without lag, cycling, intermittent action or over and under "hunting."

V Portable Tachometer. Now available is the Metron synchronous-speed tachometer for measuring speeds at approximately the two synchronous speeds of 1800 and 3600 rpm. It is available in three models.

The head of these tachometers is a simple contact-making mechanism operated by the rotation of the spindle. This contact mechanism periodically charges a condenser through a d-c milliammeter which indicates average current. Scales are exactly linear and easy to read. Accuracy ¼ of 1 per cent.

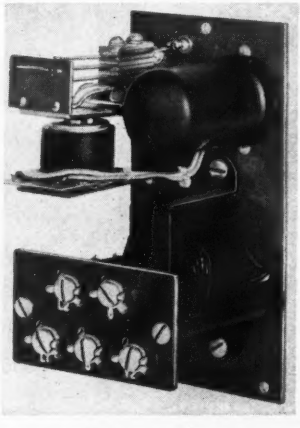


Operation is from the 115 v a-c power line without vacuum tubes. No warm-up period is required, and the tachometers are stabilized against line voltage variations. It is extremely simple to operate—only two controls; on-off switch and high-low range switch.

The tachometer is used for overspeed trip-out testing of turbo-generators, production testing of electric motors, motor efficiency tests, motor overload tests—any testing requiring accurate determination of speed at or near the synchronous speeds.

W New Super-Sensitive Relay. An electronic relay which utilizes an entirely new principle — the hot-cathode thyratron — may be used in electrical control circuits with advantage. Principle characteristics are: snap acting; high load contact capacity; trips by either: (a) an external contact carrying only 3 microamperes; or (b) any external circuit whose value drops to 1 megohm pure resistance.

Applications for the device are: In photo-cell circuits, for direct controlling actuation of motors, valves, alarms, etc.; motion and limit control within micro-inches; converting delicate contact-making instruments (such as mercury column thermometers, meter relays, recorders, precision gauges, electrical flow meters) into positive control devices without

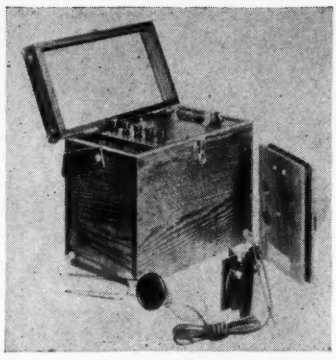


causing arcing or welding of electrodes; liquid level control—where electrodes may be immersed in a tank and govern low-level and high-level limits. Operation is from 110 v, 60 cy a-c lines.

X Cable and Pipe Locator. To the location of shorts, crosses, grounds, and wet spots, a new instrument, Stewart Cable Tester and Locator Combined, announced by W. C. Dillon & Co., Inc., now adds finding ability of most practicable service. In simple operation it tells just where cable or pipe is buried, and just how deep. It finds old cable or pipe laid many years ago on which installation records have been lost or forgotten. It locates the exact path of cable or pipe to or from buildings; finds position of a water main in street or alley; has a lamp circuit for checking all connections after test has been set up.

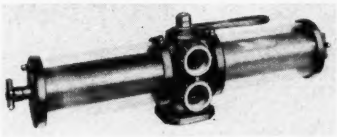
It determines whether or not a service pipe is below the frost line in lowering or regrading thoroughfare. The unit is also used to rechart a town or district where records have been lost.

It is furnished with detector coil and neutral exploring coil. Built-in



level in coil enables operator to maintain absolute accuracy. The unit is ruggedly built, easy to carry, compactly encased for rough use and weather. Size: 12½ in. by 7¼ in. by 11 in. high. Weight: approximately 22 lb, including head phones and neutral exploring coil, and fish scale exploring coil. Case finished in walnut-brown.

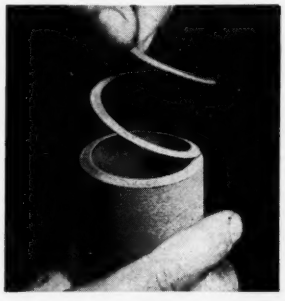
Y Duplex Strainer. A new duplex pipe line strainer has been devised that is made with a transparent Lucite casing that permits visual inspection. Without disturbing the strainer, a maintenance man, engineer or operator can readily see whether the strainer unit needs cleaning. If it does, flow can be diverted into the other chamber, without loss of pressure, and the



filled chamber can be cleaned while the pipe line maintains its normal flow. Large open area capacities afford free movement of fluids throughout the unit; 16 to 1 ratio with 12 in. tubes and 8 to 1 ratio with 8 in. tubes.

Flat horizontal design makes this strainer particularly adaptable to low, close-quarter installations. Strainers are made with bronze bodies, handle, caps, tie rods and nuts; strainer baskets are available in brass, monel or other metal specified. It is manufactured by the J. A. Zurn Mfg. Co.

Z Gasoline Purifier. This gasoline purifier is made in one model to fit almost all applications—



trucks, stationary engines and fuel oil burners.

The purifying action is as follows:

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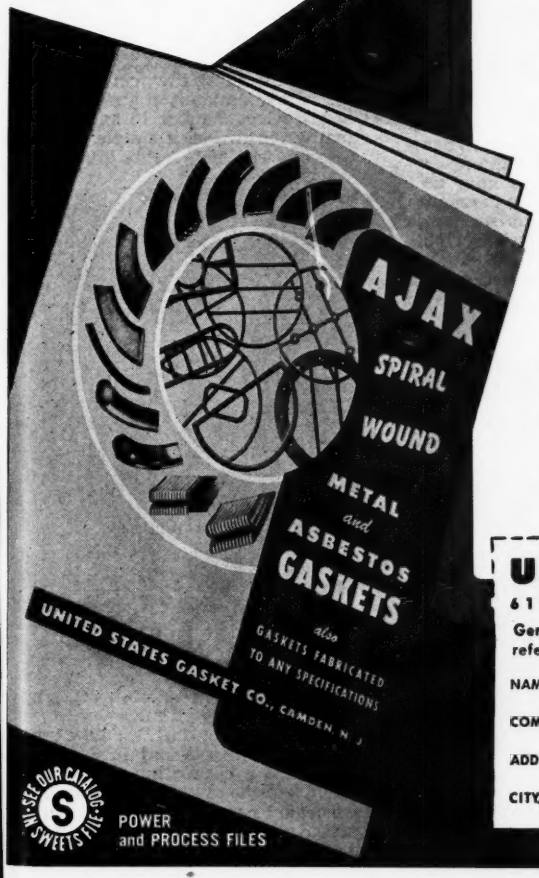

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The Skinner Purifier purifies gasoline or other fuel by passing it between layers of helically wound ribbons made from impervious material. Dirt and other impurities are stopped at the outer edges of these ribbons and fall into the sediment chamber. Any accumulations on the outer surface of the cylinder of helically wound ribbons occurring after long use can be quickly cleaned off by simply blowing compressed air, or even the breath into the cylinder.

The purifier actually separates free water from gasoline. This phenomenon can be attributed to the unique laminated construction with its almost innumerable orifices of a few microns in size, and the differences in surface tension and specific gravity of the two liquids. It is made by Skinner Purifiers, Inc.

AA Insulation Resistance Tester. A new instrument for checking insulation resistance in ac and dc equipment is announced by Ideal Industries, Inc.

Entirely self-contained, this insulation resistance tester is ready for instant use anywhere. There are no batteries or external power supplies, no brushes or commutators to require attention. The necessary power is pro-

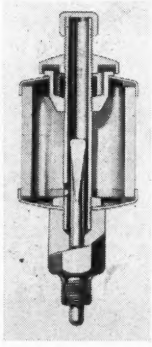
vided by a small internal hand generator which is operated by a slowly turning crank. The crank can be turned in either direction.

Correct testing voltage is indicated by two small button lights that glow at 500 dc. When the crank is turned faster than necessary an electronic voltage regulator controls the voltage to the meter so that a true reading is obtained.

Test Range is 0-100 Megohms; Case, lightweight two piece aluminum; Meter, rugged D'Arsonval type; Test leads, 10 ft. long; Dimensions, 3⅜ wide x 6 in. long x 3¼ in. high; Weight with leather carrying case is 3½ lb.

BB Vibrating Rod Bottle Oiler. This product is reported to be economical and automatic in operation. It is refillable without removing it from its installation and is furnished in a wide assortment of sizes. It is said to be unbreakable. The oiler may be used on plain sleeve bearings, line shaft bearings, jackshafts, and spindles where light or medium bodied oils are satisfactory.

It is well suited to locations where dust is a hazard. Oil is fed from an air-tight reservoir through an oil port to a feed rod which slides freely in a closely fitted hole in the base and rides lightly on the journal. A slight vibration is caused by the directional drag of the rotating shaft on the feed rod, resulting in a pumping action. As

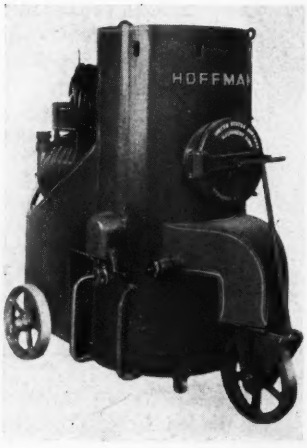


the bearing becomes warm, heat is conducted through the rod to the reserve oil, causing the air in the reservoir to expand. The pumping and thermal action forces the oil to creep slowly down the feed rod to the bearing. Since the feed rod is lubricated where it rides the shaft there is no wear on the shaft. When the shaft is not in motion vibration of the feed rod ceases and the bearing cools down and the oil flow stops. Oil-Rite Corp.

CC Portable Dust Removal Unit. The removal of coal and ash dust in the power plant is recognized as a safety measure which not only eliminates explosion and health hazards but protects machinery and instruments from damage caused by dust infiltration.

A portable vacuum cleaning unit especially recommended by the manufacturers for power plant service is the Hoffco-Vac Super-Duty Portable Cleaning Unit.

The Hoffco-Vac Unit is designed to remove large quantities of dust with



speed and economy. The 7½ cu ft capacity of the dust container permits continuous operation for long periods before it is necessary to empty the container. The unit can operate two 75-ft lines of 1½-in. suction hose simultaneously; it is equipped with crane hook connections to increase its portability.

The manufacturers state that the unit is designed for cleaning floors, walls, tops of boilers, overhead piping, and around equipment—to eliminate dust conditions which constitute a hazard and cause increased maintenance expense. It is manufactured by United States Hoffman Machinery Corp.

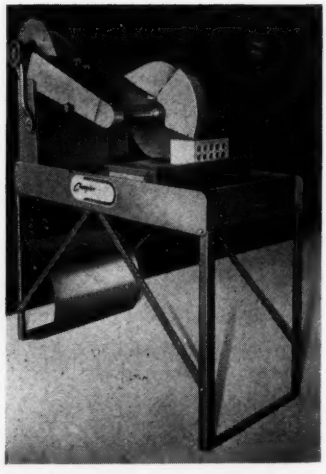
DD Portable Test Kit. The testing of boiler feedwater for hardness, alkalinity and chloride content is readily accomplished with a new boiler room test kit made by The Permutit Co.

The kit, containing solutions and precision-made pippette droppers for accurate measurements, comes in a portable white enamel cabinet, 10 in. x 10 in. x 4¾ in., and costs $15. For a slightly additional amount, it can be modified to permit the testing of sodium sulfite in boiler water.

EE Masonry Saw. A new portable dustless masonry saw for accurately cutting tile, refractory, brick and concrete block on the job has been recently developed. This new machine bridges the gap between wood cutting and metal cutting.

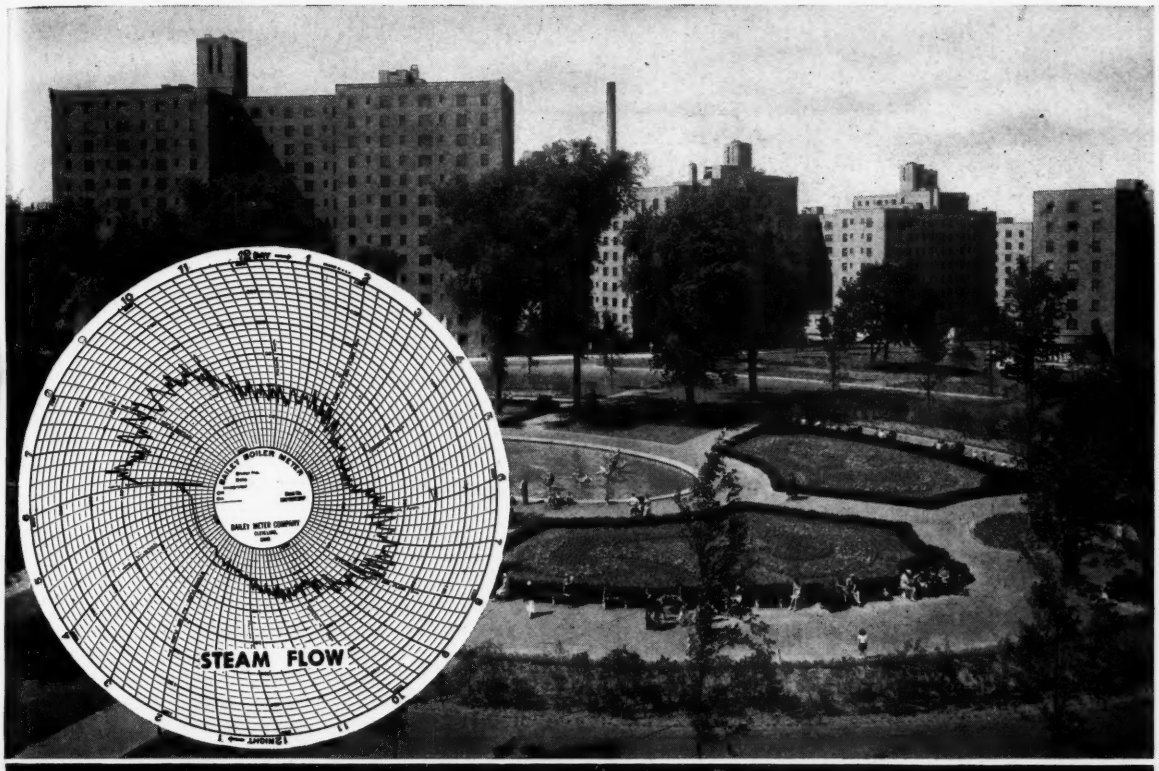
Built by Champion Manufacturing Co., with a self-contained water supply system, the new masonry saw has been created to gear tile and brick cutting to keep pace with construction.

The problem of portability has been solved by mounting saw, cutting platform, belts and motor on a stand with removable legs, similar to an ironing board, which makes it simple to pull it through windows, inside kilns, etc.

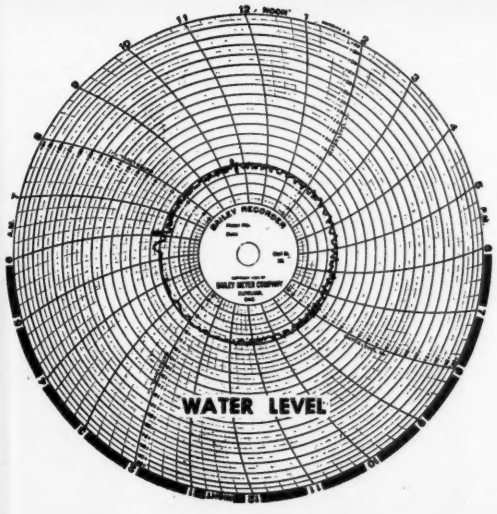


Weight is held down through use of a new type electric motor of 2 hp which weighs only 72 lb.

Second, to offset dust, the new type incorporates a self-contained water system, and a circulating pump belt-driven from the motor, which through a concealed nozzle sprays a fine mist over the cutting surface, both preventing dust and cooling the circular blade.



COPES AT PARKCHESTER



COPES is maintaining a closely-stabilized boiler water level (recorder chart) for the fluctuating loads (boiler meter chart) on the Foster Wheeler boilers in the central heating plant at Parkchester—far-famed housing project of Metropolitan Life Insurance Company.

The story behind this city within a city, its heating system and the boiler water level control is told in an interesting new COPES performance report—Bulletin 451. Write—company letterhead, please—for a copy.

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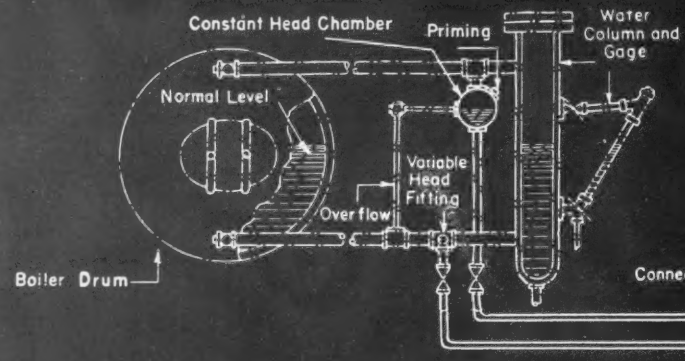

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WHAT LEADERS SAY—

The Outlook for Foreign Business

By W. E. KNOX

EVEN before World War II, the influence of machinery on production and human welfare was obvious when an examination was made of the world as a whole. It is now obvious that the two world wars have impoverished the world through the destruction of wealth-producing facilities. If a third world war is to be prevented, it is likewise obvious to all concerned that the countries of the world, with our help, must literally lift themselves by their bootstraps through industrialization and the use of machinery. This means that for at least the next three to five years, the manufacturers of machine tools should do a substanially bigger export business than during the period prior to World War II.

In planning to expand foreign sales, it is at least advisable to see what has been done in the past. Between the two world wars, that is, the twenty year period from 1920 through 1940, the total exports were over $80,000,000,000 and the total imports under $63,000,000,000. In other words, during that period, there was an excess of exports over imports of some $16,500,000,000, or a yearly average in excess of $832,000,000.

This indicated that the average plus trade balance of more than 800,000,000 dollars per year was balanced by services such as shipping and insurance, purchases of gold and silver, expenditures by tourists and by loans.

An examination of exports between the two world wars indicates that what was being paid labor influenced directly what was being exported. On products subject to mass manufacture and in which the labor cost becomes a small percentage of the total cost, the United States could dominate any free world market. Products coming under this category included such material as automobiles, refrigerators, typewriters, radios and small motors. Products in which labor represented a large percentage of the total cost could not be sold competitively in the world markets and were gradually disappearing from the list of materials being exported. Items coming under this category included many things from turbine generators to raw cotton.

After this three to five-year period mentioned above, ability to hold foreign business will depend upon ability to design and produce better machines than foreign competitors. On the simpler type of equipments it will not be possible to be competitive with countries where relatively efficient and capable labor is available at a fraction of the cost in this country.

It is now obvious that at least for several years the world will be in urgent need of American products and to a far greater degree than before World War II. At the same time, the world has relatively little gold to sell to this country, tourists will not go abroad in large numbers until at least relatively good food and living facilities are available and, because a substantial majority of the shipping of the world is owned by the United States, foreign nations will not be called upon to perform this service.

In addition, the war has changed many previously fundamental trade balancing factors; for example, rubber.

Taking all of the factors into consideration, it is reasonable to assume that this country's plus trade balance will be many times greater than the prewar twenty year average of more than $800,000,000. This poses a primary problem as to where the dollars are coming from to pay for goods and services purchased.

The Export-Import Bank was established by executive order in 1934 and in 1945 it was made a permanent, independent agency of the United States Government with very broad banking powers. At present, its aggregate loans and guarantees are limited to $3,500,000,000, with consideration presently being given to increase this by an additional $1,500,000,000. The Export-Import Bank has done a very good job and has undoubtedly brought a great deal of business to American manufacturers which would otherwise have been lost to this country.

Another attempt on the part of our Government to help the world financial situation is the proposed British loan in the amount of $3,750,000,000; also discussions have been started with the French who wish to borrow $3,000,000,000, and the Russians wish to obtain a loan from $1,000,000,000 up.

To help the flow of trade between nations and to overcome exchange difficulties which acted as retarding factors in world commerce, the representatives of 44 governments met at Bretton Woods in July, 1944, and established the World Bank and Monetary Fund.

At the end of 1945, 35 of the 44 participating nations had approved the plan, thus putting it into effect. These 35 nations made available $7,324,240,000 toward the Stabilization Fund of $8,800,000,000 and $7,600,320,000 toward the Bank Capital of $9,100,000,000.

At present I do not understand how in the long run this World Bank and Monetary Fund is going to balance foreign trade for, in my opinion, final payment for goods and services—other than by gold—can be made only in goods and services. However, let me say this—once the World Bank becomes active, my Company will become thoroughly familiar with all of its operations. In the meantime, it is obvious that at least for several years, foreign purchasers will be able to secure dollars through the World Bank with which to buy American products. It is up to you to get your share.

William E. Knox, vice-president of the Westinghouse Electric International Co., was born in Somerville, Mass., raised on his father's farm at Madbury, New Hampshire, attended the Madbury Grammar School and Dover High School and was graduated from the University of New Hampshire with a Bachelor of Science degree in 1921. He joined the Westinghouse Co., enrolling in the graduate student course at the East Pittsburgh, Pa., Works and a year later was transferred as a sales clerk to the New York headquarters of the Westinghouse Electric International Co. He began to specialize in the application of electricity to the oil industry and power plant equipment in this country and abroad. In 1932, Mr. Knox was appointed assistant to the general manager, and in 1937 was named assistant general manager. In 1940 he was awarded the Westinghouse Order of Merit, highest honor bestowed by his Company, and in 1942 won the Chilean Order of Merit, with the rank of Commander. He is a member of the Export Managers Club and vice-president and director of the Electrical Export Corp. The above is from an address before the Machine Tool Forum held by Westinghouse at Pittsburgh

Fig. 1. Marine growths on a circulating water intake bar rack. Rack had been completely cleaned two months before this photograph was taken

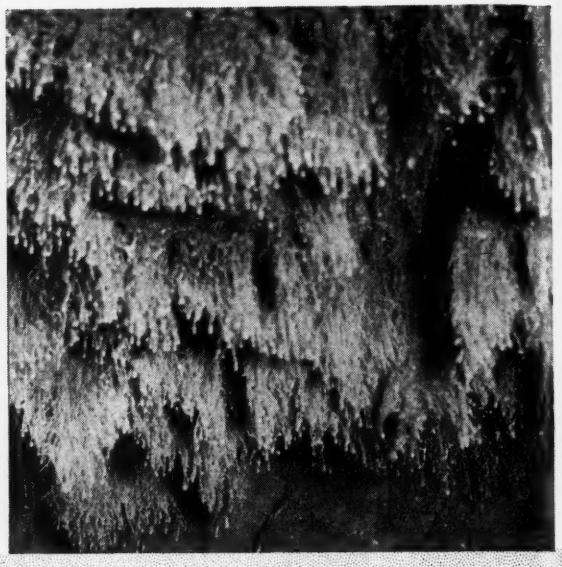


Fig. 2. Luxuriant growth of *Tubularia Crocea*, 7 in. long, on ceiling of a concrete tunnel. Some have dropped and decomposed on tunnel floor in four months since last cleaning

How to Control Marine Growths in Circulating Water Systems

TO THE OPERATOR of a steam power plant using ocean or certain lake waters for cooling water, the growth of marine fouling organisms in tunnels, circulating water inlet pipes, and condenser water boxes, has been a constant source of annoyance and maintenance difficulties. The expert in biological problems will name these organisms with long, scientifically exact names, such as *Mytilus edulis* for the black mussel, *Bryozoa* for the moss-like organisms which are quite often called grasses by the layman, or *Mogula* for the transparent round balls which squirt water from small orifices when they are left in the air. In various localities these fouling organisms are known by their common local names: clams, oysters, mussels, squirt balls, grasses, seaweed, etc. Unfortunately different names are applied to the same organism in different localities, and equally the same name is applied to different organisms in different localities.

By whatever name the fouling organism is called, however, the problems of matted growth and innumerable shells breaking away from tunnel sides, clogging tube sheets, injuring circulating water pumps, reducing water flows in circulating water inlets, and lodging in condenser tubes causing severe erosion, add up to decreased vacuums and increased maintenance troubles.

Troubles from Marine Growths

For example, one New England power house has annually removed over 250 tons of shells and accumulated moss-like growth from its circulating tunnels. Another station, which has no basic electrical interconnection and therefore is unable to de-water its tunnels, has accumulated shells to the depth of 3 to 6 ft in their inlet tunnel which has a cross-section of 6 ft by 11 ft. Several cases are on record where shelled organisms have completely clogged the inlet water lines of small power stations using 18 in. or 24 in. cast-iron pipe for their inlet supply.

Other users of circulating water from similar sources have still more serious difficulties. Where salt water is used for fire service, a mat of shells has been known to break off from the fire line and completely clog across hydrant openings or fire nozzles. Where such water is used for displacement of gasoline in underground storage, the presence of such shells may cause difficulty with inlet valves and metering equipment.

Control Now Practical and Economical

Until a few years ago the growth of these organisms was considered a necessary evil, and the control of them was considered impractical. More recently, however, careful experimental work, followed by adequate plant scale demonstrations, has proved that these organisms can be controlled. It has now been found that such control is not only successful, but economical both from the viewpoint of reduced cost of cleaning the lines by mechanical methods and the reduced cost of maintenance of equipment caused by these difficulties. Where chlorine is used for the control of these organisms, an additional dividend, usually sufficient to pay the cost of installation of equipment and operating expenses within a year or so, is obtained by the improvement of heat transfer and improved vacuums due to the elimination of microbiological slime on the heat exchanger surfaces of steam condensers.

How the Marine Growths Reproduce

However, before specific recommendations regarding control of a particular organism at a particular plant can be undertaken, details of the life and habits of the particular organism must be thoroughly understood. Most invertebrate animals are capable of three methods of reproduction:

1. Reproduction by budding or

Fig. 3. Pump suction bell in tunnel of Fig. 2, with large growth of mussels large enough to blanket tube sheets if they break off in mats or lodge in tubes if they break off as individuals

Fig. 4. Close-up of pump bell of Fig. 3. Area at right has had mat of mussels torn off to show depth of growth. Hand merely indicates dimensions

physical separation of a single organism into two separate organisms. The *Bryozoa* and *Tubularia,* often mistaken for grasses and sticks in circulating water tunnels, are typical of organisms reproducing in this manner.

2. Reproduction by production of a resistant or spore-form which consists of a minute egg-like form which will survive unfavorable environments for a considerable time and which will burst out into full growth when favorable conditions for life return.

3. Actual sexual reproduction, which is possible in almost all the invertebrate animals.

The latter is the most common means of forming new areas of fouling. The black mussel, *Mytilus edulis,* which has been responsible for the majority of the fouling by shelled forms on the Northeastern coast of the United States, and its cousin *Mytilus Californianus,* which has been responsible for most of the shelled fouling on the Western coast, has a means of sexual reproduction similar to a large number of other invertebrate animals. Sometime between May and October, in waters near New York City, the female will discharge between five and ten million eggs into the open sea. A moment later a male, attached nearby, will release sperm and the eggs are fertilized in the open water. Within twenty-four hours the fertilized egg has developed into a free-swimming ciliated organism, and by the end of three days has settled on some hard surface to which it can attach and has begun the formation of the shell structure.

Such a shelled organism is normally attached to the surface by long clear threads called byssuses, which project out of the hinge of the shell and are attached to the hard surface by an adhesive material. During normal life processes, the organism will remain in the water with its shell partly open and will circulate through its digestive tract approximately two gallons of water per day. From this water it removes both the oxygen necessary for life and its food material. If anything occurs to disturb the organism such as a shadow passing over it, a sudden flash of light, an increase in water temperature, introductions of poisons into the water or reduction of oxygen content, or any one of a number of other stimuli, the organism will immediately close its shell and keep it closed for a considerable time.

If the unfavorable conditions continue, the organism will break its byssus threads and crawl with the aid of a "foot," which it projects out of its shell in a manner similar to the familiar terrestrial snail, to a new point of attachment. This ability of the shelled organisms to close and remain closed for a considerable period of time makes the control of such organisms quite difficult. This factor should be borne in mind in any plan of control.

By John G. Dobson *Industrial Division, Wallace & Tiernan Products, Inc.*

Keep vacuum and heat transfer high, maintenance low, by controlling the mussels, oysters, squirt balls, grasses and other organisms that clog up circulating water piping and tunnels, tubes and tube sheets, pumps and water passages in fresh and salt-water systems . . . Combining the "know-how" of the power engineer with the "know-why" of the biologist, this article shows how such control is today practical and economical . . . Control or complete prevention; different procedures for each . . . Various methods employed; chlorination found most effective . . . How chlorine kills the organisms . . . How much chlorine; how often to use it . . . How to start control operations . . . Precautions in chlorinating large water flows . . . Seasonal factors; temperature; tides; survival of organisms . . . Rates of fouling

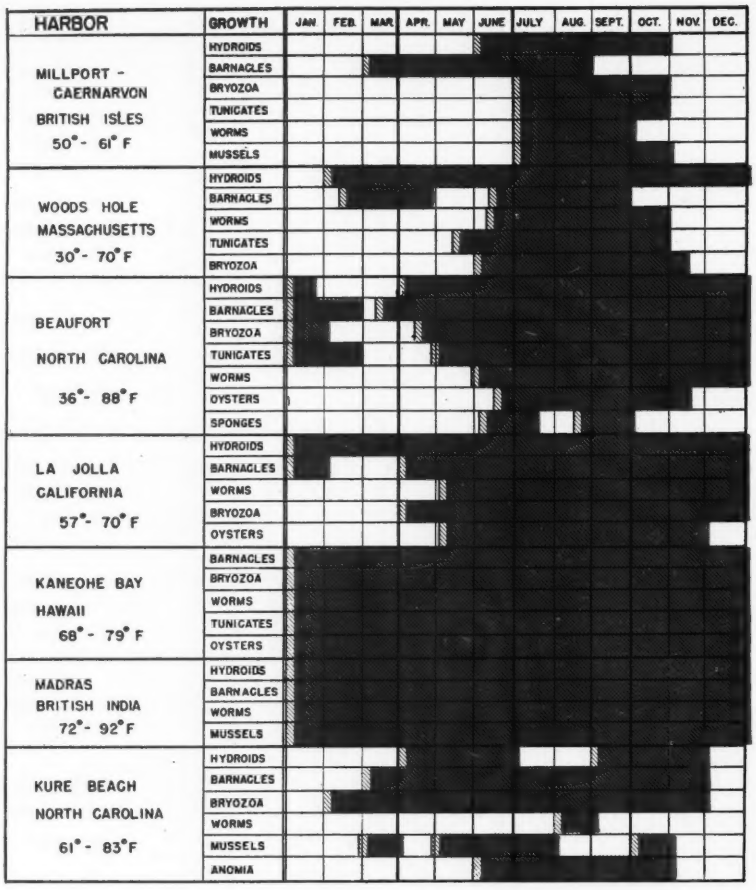


Fig. 5. Fouling periods in various American and foreign harbors

General Methods of Killing Fouling Organisms

A number of methods have been suggested and tried for the elimination of these fouling organisms. Among them are the heating of the water, increasing or decreasing of the salinity of the water for extended periods, the creating of oxygen deficient conditions in the water, the increasing of water velocity in the tunnels or pipe lines, the poisoning of the organisms with acids, the inhibiting of the attachment of the organism with anti-fouling paints and surfaces, the screening of the tunnel entrance, the poisoning of the organisms with miscellaneous poisons, and the killing of the organisms with chlorine.

Heating the circulating water has proved successful in several power stations. However, in order to do so a large amount of heat must be wasted to the circulating water either in the form of waste steam or in the form of throttling of circulating water flow, with increased back pressure and loss of turbine efficiency. Maintenance difficulties are sure to develop when a condenser is operated at 120 or 130 F. The uneven expansion of such heating will cause warpage of tube sheets and, water tubes, and leaking of tube ferrules.

Changes of salinity will kill certain organisms, but others are extremely resistant to such changes. The method is not usually economically feasible, since such enormous quantities of fresh water are seldom available on salt water installations. In small pipe lines, increase in velocity may well act as a satisfactory control method. Velocities of at least 13 ft per sec will quite often remove fouling loads which have not become too closely attached. However, if such methods are used, adequate screens must be placed in the circulating water line to prevent injury to equipment by the large quantity of shells which are loosened by such a flushing method. It is seldom economical to install pumps of sufficient capacity to provide such velocities.

Reduction of pH

The reduction of pH, by the addition of acids, to values between 5 and 3 will kill most of the organisms if carried out for extended periods. Cost of acid for such a treatment is usually excessive, and such low pH values will cause severe corrosion to plant equipment.

Anti-Fouling Paints

In very recent years, large strides have been made in the compounding of anti-fouling paints, and the use of such materials is now economically feasible for equipment, such as trash racks, bar screens, and other metal equipment which must be removed for painting on a regular schedule. Anti-fouling paints, to be efficient, must leach out a fixed quantity of copper or other poisons at a steady rate and for this reason they should always be used as a finished coat after the corrosion-resistant paints have been applied.

Screening of water inlets has been suggested as a means of control, but since the fouling organism in the stage at which they usually enter the tunnels is less than 0.01 in. in diameter, the idea is impractical.

Poisoning the Organisms

Active poisons, particularly petroleum by-products, have been used at various times to attempt to control fouling organisms in circulating water tunnels. It is fairly successful in the control of the organisms between high and low water mark, since it causes the surface to be unattractive as a point of attachment. However, use of any active poison which does not dissipate itself by reaction of normal sea water will carry such poisons out into the open sea and cause injury to oyster beds, fishing, and bathing at near-by beaches.

Control by Chlorination

Chlorine is the most economical and widely used means of controlling fouling organisms in both salt and fresh water circulating systems. It has proved successful in many plants throughout the world. Early attempts to use chlorine were based on continuous chlorination. Later, short intermittent treatments were found unsuccessful. We have now found that properly spaced intermittent treatment schedules are more economical than continuous treatment and are completely satisfactory.

It will be remembered that all fouling organisms have a spat or larvae stage during their sexual reproduction and that infections in new areas can only begin by the coming in of such larvae. Therefore, if the larvae can be killed at regular intervals, before they have completed metamorphosis, or transformation into adult growths, no new fouling will occur. In this the design engineer is fortunate, for most organisms during metamorphosis have a higher metabolism than at any other time in their life and, therefore are more vulnerable to poisoning.

Complete control can be accomplished by intermittent chlorination if the treatment periods and dosages are repeated at frequent enough intervals. At first thought, it would seem that the chlorination periods could be spaced at intervals only slightly shorter than the time required to complete metamorphosis of the responsible organisms. However, there is always the possibility that some larvae will arrive in the tunnel in an advanced state of development and will complete metamorphosis almost immediately. When it

is realized that a normal fouled shoreline may contain a thousand million barnacles per mile and that these will release a million larvae, or that a single *Mytilus edulis* may release as high as 25,000,000 eggs, it will be realized that only a very small percentage of the larvae need escape to cause serious difficulty.

Complete Prevention vs. Control

A distinction should be drawn between complete prevention of fouling and substantial reduction or control of fouling. In all cases where fouling must be completely prevented, continuous chlorination during the fouling season must be used. However, where only control is required, intermittent chlorination may be used more economically. In those cases where intermittent preventive treatment is to be used, the lines should be purged by continuous treatment for short periods at regular intervals. Glass flanges should be inserted in pipe lines, or test blocks should be inserted into tunnels and observations made at weekly intervals. As soon as the residual fouling, that is not being prevented by the intermittent treatment, reaches the point where the organisms threaten to cause plant operating difficulty, then a corrective treatment should be instituted. This treatment will consist of chlorination at higher residuals and for longer periods than the preventive treatment. The reason for this longer period is obvious, since most shelled organisms are capable of closing and remaining closed for long periods. Chlorination periods must be extended until the organisms are forced to open their shells to obtain food or oxygen.

How Chlorine Kills the Organisms

Observations by the writer on experimental troughs will illustrate the method of killing adult organisms. A large group of shelled *Mytilus edulis* of varying size was placed in untreated wooden troughs through which fresh sea water was continuously circulated. Time was allowed for the organisms to become acclimatized, and no treatment was begun until all specimens were fully attattached by byssus threads. Chlorination was then begun in different troughs at levels sufficient to yield 2.5, 5.0 and 10.0 ppm chlorine residuals.

Figure 6 illustrates the rate of detachment and rate of killing of these adult organisms. It will be noted that the mussels break their byssus threads and attempt to migrate to more favorable environments before chlorination actually kills them.

Most larvae, as contrasted with adult forms of fouling organisms, are killed by chlorine residuals of 0.5 ppm applied continuously. This has been confirmed by experience at various places along the Atlantic Coast from Massachusetts to Florida. However, on one plant scale operation in Virginia, 0.5 to 0.6 ppm chlorine residuals maintained continuously, failed to control mussels and barnacles.

In another case, an electric plant in New England chlorinated during one season at 0.5 ppm chlorine residuals on schedules of 20 minutes each, six times per day, and obtained complete slime control on condenser tubes, but showed no noticeable reduction in their annual accumulation of 600 cu ft of mussel and barnacle shells. The following season the same plant chlorinated at residuals of 0.7 ppm on a schedule of two 1-hour periods per day. The accumulation that year was 25 cu ft. Further reduction could have been effected.

How to Start Control Operations

Because of physical variations among different plants with regard to water circulating tunnels, the piping arrangements, as well as predominating fouling organisms, these experimental results and previous plant experiences should be used as a basis of design in other plants only with extreme caution.

Care should also be taken in instituting plant scale operations. For instance, in the beginning of treatment of a circulating water system that has been in use for some time, a large quantity of organisms, usually sufficient to block tube sheets and often sufficient to cause serious damage to circulating water pumps, will be released if curative treatment is immediately applied. To prevent this, chlorine residuals should be held at low levels and chlorination periods should be short at the beginning, gradually lengthening as less and less fouling organisms remain in the tunnel.

It is quite often more economical, when instituting preventive treatment, to mechanically clean the entire system, if the penalty for shutting down of the plant is not too high and the problems of de-watering not too difficult. It is possible to use conventional main cleaning equipment for small water conduits and to send in a gang of men with rakes, shovels, and wheelbarrows to remove the accumulation in large tunnels. Such a process can also be used for the seasonal check and for the removal of small accumulations which have been permitted to grow by reduction of amount of preventive treatment in the interest of economy.

Regular Schedules Important

In the preventive treatment, extreme care must be taken that the regularity of intermittent schedules be not interrupted, in view of the speed of the formation of protective shell coverings of many of the organisms. The need of such regularity would seem to be axiomatic. Nevertheless, a good many operators will unthinkingly omit water treatment for considerable periods of time during plant shut-down periods. Periods with reduced flow, lower velocities, and untreated circulated water are the ideal conditions for the beginning of fouling.

How to Apply Chlorine to Large Water Flows

The means of applying chlorine to large circulating water flows should be carefully considered. Chlorine is only slightly soluble in fresh water and is still less soluble in salt water. For this reason special apparatus for obtaining completely dissolved chlorine in water solution must be provided. In order to achieve marine growth control in large tunnels and pipe lines, the chlorine solution must be evenly distributed through the circulating water flow. Unless wide experience is available as to the type of flow that will be found in screen wells and suction chambers, it is likely that a point of application and means of diffusion will be selected which will completely free one area of serious growth and permit uncontrolled growth in other areas. It should be also remembered that, while chlorine in the low concentrations required for the killing of these

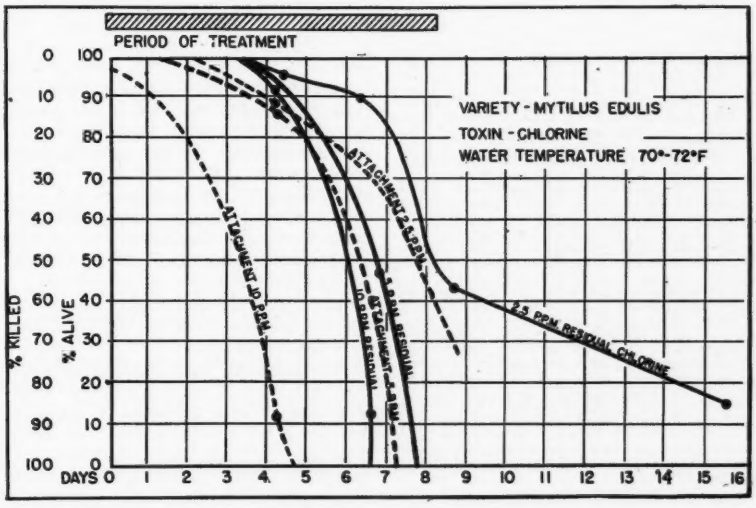


Fig. 6. Time required to force mussels to detach and to kill mussels in various concentrations of chlorine

organisms is not corrosive to normal materials of construction, it is highly corrosive in higher concentration and particularly if released as a gas. Therefore, if adequate mixing and dilution are not provided, local areas of high concentration may severely corrode pump bells, impellers, and casings.

Chlorination Will Not Affect Surrounding Waters

The chlorination of circulating water will have no adverse effect on oyster or clam beds lying off shore or on near-by bathing beaches. This can be readily appreciated when it is realized that the "chlorine demand" of normal sea water is such that the mixing of chlorinated water with an equal volume of sea water will eliminate or materially reduce the residual chlorine so as to be no longer toxic to oyster beds. The residuals[1] carried approximate those used in swimming pools; therefore, if pH is maintained as it will be by the natural buffer capacity of sea water, beneficial rather than harmful effects would occur from swimming directly in the discharge water.

Seasonal Factors in Chlorination

During periods of the year when fouling organisms are not reproducing, it is of course, unnecessary to chlorinate at the higher residuals necessary to kill larva form. However, in most industries it is not advisable to completely cease chlorine treatments since the advantages obtained from chlorination, such as improved vacuums on steam condensers, improved heat transfer on stills, etc., more than compensate for the cost of continuation of treatment. The cost of marine fouling control with chlorine is usually lower than either the equivalent cost of manual cleaning of the same water circuits or the cost of maintenance difficulties arising from failure to clean. A 25,000-kva generating station on ordinary estuary water, is able to achieve control for about $3.50 per day during the fouling season. In waters near New York and Boston the fouling season will be less than 6 months out of the year.

[1] Throughout this discussion the term "chlorine residual" has been used to indicate a free chlorine residual or active HOCl as contrasted to a bound or chloramine residual, where the chlorine is bound by reaction with ammonia or amino compounds. Recent work has indicated the wide difference between the killing power of chlorine and chloramine residuals. Chloramine residuals have distinct use for specific purposes, since they are more stable in the presence of organic matter. They are therefore highly useful for the sterilization of swimming pool water, and stock and pulp systems in paper mills. However, where ammonia content is not high, and this is true in most applications where marine fouling by macroorganisms is a problem, the use of free chlorine is recommended. Unfortunately, even if no ammonia is added, chloramine residuals often still occur because of the high ammonia and amino nitrogen content of water which has been subjected to organic pollution. In those cases a question arises as to whether it is more economical to use "Break Point" chlorination and remove the ammonia, or whether it is more economical to take the longer killing periods and higher required residuals of the chloramine.

In addition to the savings resulting from elimination of marine fouling, the savings due to improvement in steam vacuum will almost always be sufficient to warrant chlorination of the cooling water without reference to the marine fouling problem. A steam station with initial conditions of 450 psi and usual regeneration and feed water heating but without process steam bleeding, will save approximately 7 per cent of their total overall cost by improving their condenser vacuums by 1 in. Elimination of slime accumulation on the tubes will often improve the vacuum considerably more than this amount.

It should be remembered that the designer of the steam condenser has assumed that the water side of the condenser will only have heat transfer of 85 per cent of the transfer of the clean tube. Proper condenser cooling water will permit the condenser tube to operate at heat transfer rate equivalent to clean tube conditions. The additional savings which result from the continual operation of the units without shut down for cleaning, and which result from lack of cleaning costs, are substantial from a monetary viewpoint and are still larger when one considers the elimination of this very disagreeable cleaning job from the power house schedules.

What Determines Rate of Fouling?

The time of year during which fouling will occur and rate of fouling will be dependent upon the fouling organism responsible for the difficulty, upon the water temperature, and upon the particular season. Seasonal variations are in turn dependent upon whether a large or small group of adult organisms succeeded in establishing themselves in the near-by waters during the previous reproductive periods, and whether these organisms survive to the next breeding time. Conditions of tide, particularly as it affects water temperature, will also influence fouling periods and rates. These factors are too numerous and varied to permit accurate forecasting. To obtain this type of information, the William F. Clapp Laboratories of Duxbury, Massachusetts, and the Woods Hole Oceanographic Institution of Woods Hole, Massachusetts, have maintained for a number of years test blocks and panels at a large group of stations on the Atlantic and Gulf coasts and elsewhere. These specimens are returned to the laboratories at regular intervals and examined to determine both settling rates and growth rates for the particular station and time. From these examinations enormous quantities of valuable information have been amassed.

The technique of setting such panels, in order to obtain reproducible results over a long period, is beyond the scope of this paper. Color and material of the panel, depth and angle of submergence, type of support, and location of the tested area with respect to contaminating influxes and tidal rips are a few of the factors to be considered. While results obtained from such test blocks cannot be used to forecast particular conditions at a station unless those tests are taken from the circulating flow of that particular station, some of the published results may be of interest. Fouling periods[2] at widely scattered points are shown in Fig. 5. In shipping or storing specimens for later examination, they may best be preserved by draining surplus water from them and placing in sealed bottles containing 98 per cent alcohol.

How to Design for Fouling Conditions

In the design of new plants using fresh or tidal water likely to foul, two questions must be answered. First, what will be the extent and nature of the fouling organisms? And second, what design steps must be taken to overcome them?

Often forecasts of fouling conditions have been made, based on studies of test panels or of fouling on logs, piers, rocks, and structures near the site of a proposed plant, or on studies of fouling conditions at an adjoining plant.

Such forecasting is extremely dangerous and should never be relied upon. Industrial water supplies taken from large bodies of water usually afford ideal conditions for invertebrate growth in their screen chambers, pump suction wells, supply pipes and flumes.

The organisms, since they are capable of only limited movements, are naturally dependent on water motion to carry their food to them, and therefore will thrive and grow at rates unprecedented on the previous shore line. This is naturally due to water velocities usually in the range of 1/10 to 2 ft per sec. Differentials of growth rates as high as 3 to 1 have, for instance, been recorded, for barnacles in wave-swept waters, as compared with barnacles living in comparatively still tidal water. Still faster rates of growth have been noted in industrial tunnels. Where the water taken by the industrial plant is used for cooling, an additional unforecastible factor is introduced. The enormous heat output in cooling water from a large power station or refinery is often sufficient to shift the overall temperature of the body of water as much as 15 F. This shift in water temperature may be enough to encourage year-around growth and reproduction of an organism that has previously been dormant a large part of the year; or it may permit over-wintering and luxurious growth of some organism which has been previously subject to seasonal extermination.

A good example of this occurred in

[2] Data compiled by the above methods for a number of American harbors became available just as this article was going to press, too late for inclusion here. These data will be published in a future issue.

the southwest during the war. A new plant was to be erected on tidal water and take its cooling water flow from a brackish stream only a few hundred feet from the inlet of an existing oil refinery. Design engineers, basing their judgment on the fact that the existing plant had experienced no difficulty, and upon a belief based on rather limited experience that no organism could thrive on varying salt content water, provided no protection from fouling. Luxuriant *Bryozoa* growth shut down the plant before a single year's operation had been completed.

For another example, there are two power stations in Rhode Island whose cooling water inlets are a city block apart. Neglible differences exist between the plants so far as salinity, water temperature, sewage pollution, and other normal factors are concerned. The plant upstream from the sea has had severe fouling with *Mytilus edulis;* the one nearer the sea has had none. The difference probably exists in variations in river bottoms. Some plants have experienced severe fouling recently after a period of comparative freedom, probably due to changes in industrial and domestic pollution in their water source.

It should be realized that, even though conditions are known to be unfavorable to the fouling organisms that exist near the proposed plant site, these same conditions of salinity, temperature and pollution may encourage luxurious growth of some other organism, not now native, when changed water flow and temperature due to the new operations occur.

Safest to Design for Fouling

It is only sound engineering to design as though fouling will occur. Satisfactory design will require that all portions of the system be accessible for inspection and manual cleaning; and preferably be capable of being readily dewatered; but such manual cleaning should be considered only as an emergency measure. From the standpoint of efficiency, of continuity of operation, and of cost of cleaning; control methods as previously discussed, are more satisfactory than manual cleaning. Designing with such control methods in mind from the very inception of plans will often substantially reduce corrective construction and operating costs.

Boiler Scale Removal by Chemical Cleaning . . . .

[redacted]

By Bradford J. Cotey
Technical Department, Turco Products, Inc.

PRACTICAL APPLICATION of surface chemistry to the problem of removing scales and sludges from steam generating equipment has resulted in the development of chemicals that are effective, safe, and easily handled. These chemicals, with methods of application readily adapted to plant practices, combine to form a fast and economical cleaning operation. The descaling is thorough and can be accomplished with a minimum of dismantling of equipment or interference with normal plant operation.

It has long been known that certain acids are capable of dissolving some of the deposits usually found in boilers. There was at the same time, however, a reaction with the metals which precluded their use for this purpose. In order to utilize these acids to remove accumulations of scale and sludge from metal surfaces, it was necessary to develop suitable acid inhibitors.

In addition to reducing the rate of attack on metal to a fraction of its former rate, without affecting the reaction on the scale or sludge, certain other requirements were necessary for a satisfactory inhibitor. Any tar or oily deposits that might result from the alteration of the inhibitor through chemical action or temperature is objectionable, since it may cause foaming and priming.

Metal or metallo-organic base inhibitors are not always satisfactory as their efficiency is generally dependent on the metal plating out on the surface. If the metal film is not removed by flushing and neutralizing following the acid cleaning, it may be carried over when the boiler is put back on the line to be redeposited on the turbine blades or cause other operational difficulties. Furthermore, the inhibitor should be relatively nontoxic and offer no occupational hazard.

Investigation of various inhibitors for controlling acid reactions has disclosed that the best type of inhibitor to use depends on the concentration and type of acid and the process employed. For example, foam type inhibitors for both sulphuric acid and muriatic acid have been developed which find a ready application in acid pickling operation but are definitely not suitable for boiler scale removal. An inhibitor may give adequate protection at atmospheric temperature, but allow excessive corrosion at temperatures of 150-175 F., as frequently encountered in boiler cleaning. An acid properly inhibited for steel may be corrosive to bronze, and consequently, each of the metals to be encountered in the entire system must be considered in the proper selection of the inhibitor.

The optimum amount of inhibitor to use is dependent on the surface area exposed and the concentration of the acid solution. For most operations where small surface areas are exposed to large amounts of acids, 1 percent of inhibitor based by volume on the amount of concentrated acid will prove to be satisfactory. Where large surface areas are contacted by relatively small volumes of acid, as in boiler cleaning, from 0.3 - 0.5 percent by volume of inhibitor, regardless of the acid concentration, is required for adequate corrosion control.

Chemical Composition of Scale

Scale and sludge found in boilers varies according to the chemical composition of the water being used, the type of feedwater treatment being given, the operating temperature, and

the pressure of the unit. It will be found that in the majority of cases varying amounts of iron oxide will be found either in the form Fe_2O_3 or the magnetic iron oxide Fe_3O_4. These compounds result from the oxidation of the steel in the boiler, and the amount and type can be controlled by proper feedwater treatment. In those units where internal treatment with one of the phosphate compounds is made, a calcium hydroxy-phosphate sludge is usually deposited. Calcium carbonate, calcium sulphate, as well as silica are found in boilers in varying percentages. Oil or grease may also occur.

Composition of the scale and sludge found in the boiler will dictate whether or not a successful removal can be obtained by the use of chemicals. Carbonates and phosphates are quite readily removed, and it is only necessary to ascertain how much scale is present to determine the proper concentration of scale solvent. The silicate scales and iron oxides present a more complex problem, and certain additive agents must be used in addition to the acids. Also in the case of these minerals, it is often found necessary to use elevated temperatures in order that the job will not be prolonged for too great a length of time. Pure silica and pure sulphate are practically impossible to remove successfully by the use of any known chemical solution. In the majority of cases, however, they are found in conjunction with other materials which are soluble and by removing the soluble portion of the scale, the former may often be successfully removed.

Any oil found in the boiler may be removed by a treatment designed specifically for that purpose. If the amount of oil is not too great, it may be removed along with the inorganic material by the use of suitable agents in the solution. An oily condition may exist which will seriously interfere with the removal of the inorganic encrustation, in which case it is advisable to remove the oil by an alkaline boil-out prior to the scale removal treatment.

In order properly to prescribe a chemical scale removal treatment on a boiler, it is necessary to know what type of scale is to be removed. It might be well to mention that in a great many cases it will be found that the scale is made up of layers of different minerals. Quite often an iron oxide is next to the metal, then a layer of sulphate or silicate, then a layer of carbonate or some other material. Simple solubility tests usually give adequate information to prescribe the best cleaning operation. For this reason, the ideal sample is a section of a tube taken from the boiler in order that tests may be made on the material as it is found. If a section of tube cannot be obtained, it is essential that the material be scraped completely down to the bare metal so that each individual layer will be present in the scale sample.

Cleaning Methods

There are two general methods of cleaning boilers; the fill-and-soak method and the pump circulation method. Each has its advantages and disadvantages, and a decision as to which method to use on any particular boiler is determined by local conditions. In general, it will be found that the fill-and-soak method is more applicable on the larger size boilers.

Because of the complexity of construction of these units, pump circulation will not always give a positive flow in every tube, a condition which is necessary to justify its use. Boilers are so designed that circulation results in them normally because of the differences in gravity of water at various temperatures. For that reason, if proper temperature control of the boiler and the solvent is maintained, normal circulation will result during the cleaning operation and the use of an additional pump will not be necessary.

One disadvantage of the fill-and-soak method is that the amount of solvent used must be based upon the estimated amount of scale present. If this estimate is incorrect, an excessive amount of solvent will be used which is not recoverable and which will add to the over-all cost of cleaning. In cases where too low a concentration is used, incomplete scale removal may necessitate refilling with fresh solvent.

When positive circulation is maintained by the use of a pump, the partially spent solvent return from the boiler is continually checked and fresh solvent is added as needed. In this way only the amount of solvent absolutely necessary to remove the scale is used. One disadvantage to the pump circulation method is the fact that the solutions used in descaling a boiler become more and more corrosive because of dissolved salts, and some additional corrosion may result from circulating which would not be obtained by the fill-and-soak method.

Procedure for Chemical Cleaning

Chemical treatment of a boiler consists of filling the unit with a recommended concentration of scale solvent at the proper temperature allowing it to soak or circulate until all the scale disintegrates and can be readily washed from the boiler. The unit is then drained, filled with water, and drained again to remove any residual solvent or insoluble residues remaining.

After this, the boiler is filled to normal operating level with a dilute solution of boiler neutralizing compound, brought to boiling or preferably 25 or 50 psig pressure, after which it is drained. The purpose of the alkaline boil is to neutralize any remaining acid in the boiler. This also leaves the

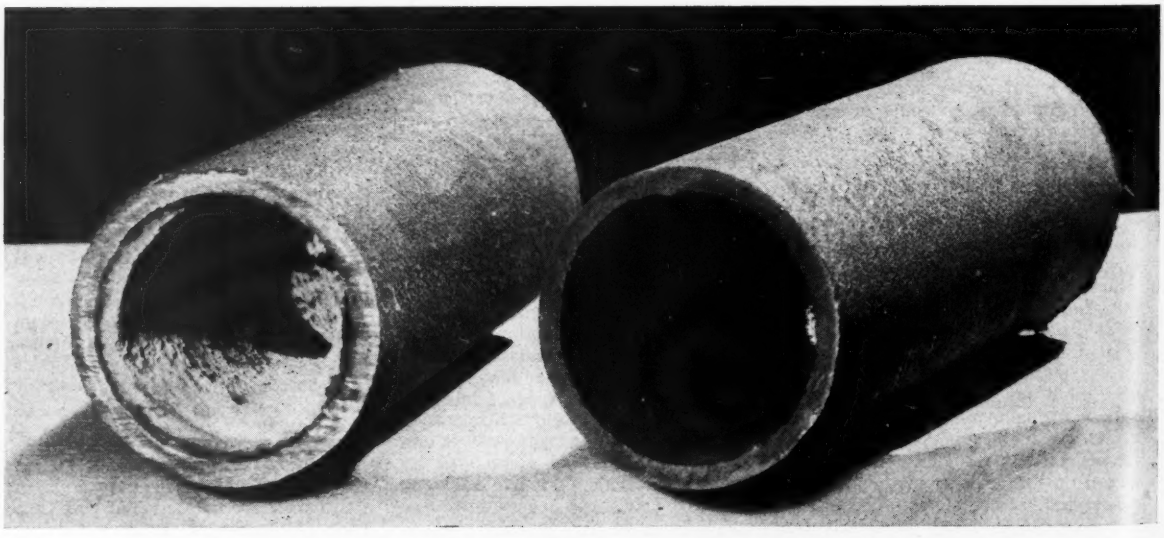


Fig. 1. (left). Sections of same boiler tube, before cleaning (left) and after cleaning (right) with chemical

metal surface in a passive state, tending to reduce the after-rusting that normally results when metal has been acid treated. In addition, experience has shown that the neutralizing boil helps to remove any loosely adhering sludge that remains and leaves the entire surface in a much cleaner condition. The boiler is then ready for inspection.

Since it is usually desirable to apply the chemical at an elevated temperature, the boiler should be pre-heated. This may be accomplished by filling or circulating the boiler with hot feedwater until the metal is heated. Whenever possible, it will be found that a more satisfactory temperature can be obtained by filling the boiler to normal operating level and firing it until the temperature is raised to around 200 F. The fire is then pulled and the boiler allowed to stand for at least an hour to permit temperatures to equalize so that no local overheating will result. This system heats the footings, settings, and brickwork and a more uniform temperature will result than when hot feedwater is used.

After an operator has become accustomed to chemically cleaning his equipment, he can usually have all preparations made before the boiler is taken off the line, and as soon as the temperature in the unit has dropped down to around 190 F treatment can be started. A great deal of time is saved by using this procedure which eliminates the necessity of preheating.

Filling the Boiler

As most boiler rooms can furnish water at practically any temperature, no steam will be required to heat the solvent to the desired temperature. Hot water is piped directly to the bottom blowdown of the boiler, and in this line a hot water meter is installed so that the water being introduced into the boiler can be accurately measured. Between the meter and the boiler a tee is installed in the line, Fig. 2, and concentrated solvent is pumped directly into the metered stream of water. By gaging the amount of concentrated solvent being pumped and metering the hot water, the proper concentration can be obtained by regulating the flow of each. This system is widely used in the chemical cleaning of boilers and has proven to be the easiest method, since the dilution is made as the liquid is pumped and tanks for dilution are not required.

On large units, those requiring 3000 to 4000 gal or more, it is advisable to run the first solution in at a slightly higher concentration than the average. For example, if a 20 percent solution of scale solvent is recommended for the treatment, it would be well to run the first one-third or so of the amount in at a concentration of approximately 25 percent, decreasing the concentration slowly, so that the last of the solvent goes in at approximately 15 percent. To insure the entrance of all of the concentrated solvent before the system is completely filled, it is necessary to regulate the rate of introduction so that all of it is in the unit by the time it is 90 to 95 percent full, completing the operation by introducing the necessary hot water to fill the unit.

Most fire-tube boilers and the less complex water-tube boilers usually can be chemically cleaned by introducing the concentrated chemical directly into hot water already in the unit. This can be done by filling the boiler to normal operating level, firing it until the proper temperature is obtained, then draining out an amount of water approximately equal to the amount of concentrated chemical that will be required. The concentrated chemical is then pumped into the top of the boiler. The specific gravity of the concentrated chemical will be greater than the hot water in the unit, and complete mixing will result in a very short time.

When quantities of carbonates are present, large amounts of gas may be generated, therefore the rate of introduction of the concentrated solvent should be regulated to permit escape of the gas through the vent. It is imperative that the concentrated solvent be pumped into the top of the unit to provide thorough mixing of solvent and hot water. After the unit is filled to capacity it is allowed to soak for a period of 4 to 6 hr depending on the amount and type of scale being removed.

At the end of the soaking period the unit is drained. Since the solution in the boiler is practically spent, it can usually be drained through the normal blowdown into the sewer without danger. Usually the blowdown lines are small, about 1½ to 2 in. in diameter, so that draining operation may be slow. Since there is always a certain amount of insoluble material that must be removed after any chemical descaling job, it is advisable to arrange the draining facilities so that the solution may be drained rapidly in order to carry out as much of this insoluble material as possible.

In some instances it will be found that improvement can be shown by flushing out the solution with feedwater. This is accomplished by closing the vent, opening the drain and immediately starting feedwater in the top of the boiler at as high a rate as the drain can accommodate. The draining solution should be checked for concentration, and as soon as it appears that most of the spent solvent has been removed, the feedwater pump can be stopped, the vent opened and the unit allowed to drain completely.

After draining, the unit should be filled with water and again drained after which it is filled to normal operating level with boiler neutralizing solution and fired to a boil or preferably to 25 to 50 psig pressure for approximately 2 hr. The same method employed in filling the boiler with acid solution can be used for adding the neutralizing solution. That is, the neutralizing compound can be dissolved in water in a concentrated form and pumped directly into a stream of hot feedwater going into the bottom of the boiler. Since the unit is to be fired and boiled, there is no particular need to regulate the concentration. It can be introduced as rapidly as possible, and the unit then filled to capacity with feedwater. Complete mixing in the unit will result during firing.

Steam Heating the Solution

In some instances where hot water is not available for diluting the solvent, it will be necessary to heat the solution by the direct injection of steam into the in-put line. This is done by introducing steam into the water stream before the solution is mixed, Fig. 3, or directly into the stream after the solvent has been mixed with water. Pre-heating the

(Continued on page 124)

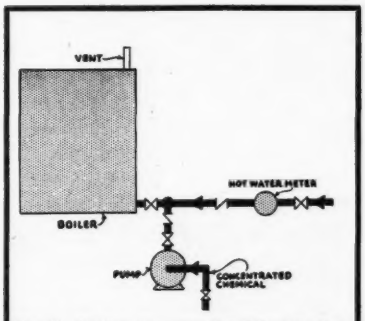


Fig. 2. Piping diagram for filling boiler with hot water and scale solvent

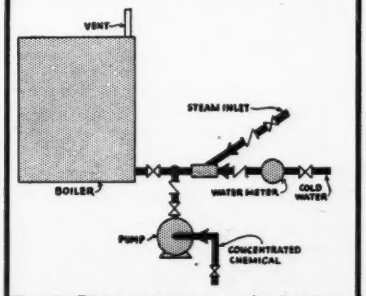


Fig. 3. Piping arrangement for heating cold water with steam

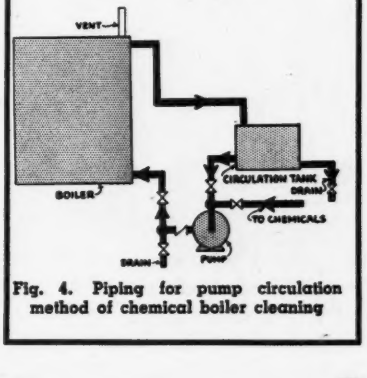


Fig. 4. Piping for pump circulation method of chemical boiler cleaning

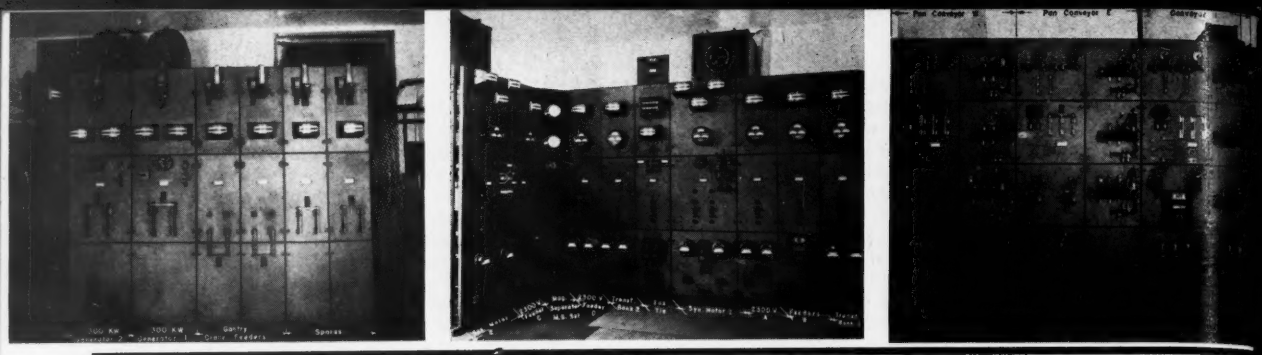


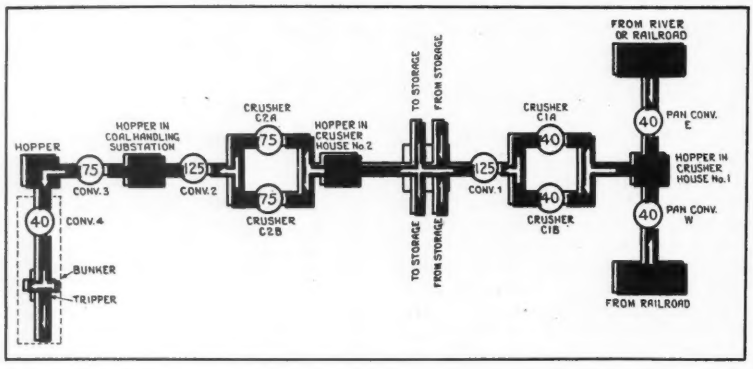
Fig. 1. Panels installed in 1924 to control original equipment of Fig. 2, filled four sides of control

Modernizing the Coal-Handling

PHILO STATION of The Ohio Power Co. is the largest central station on the American Gas and Electric System. It has a generating capacity slightly in excess of 440,000 kw. When the plant was first built* in 1924, it had two turbo-generators, each rated 40,000 kw; in 1928 a triple machine was installed with a capacity of 160,000 kw; and between 1941 and 1943, two additional compound units were erected, each capable of generating somewhat over 100,000 kw.

At present the plant burns an average of 5000 tons of coal per day and there have been days when as much as 6500 tons have been consumed. That is a lot of coal. The fuel must pour into the hungry maws of the furnaces in a ceaseless black cloud of pulverized dust, hour after hour, day after day. To supply this insatiable demand requires a conveying system of large capacity and utmost reliability. Originally the conveyors were designed for 500 tons per hour but, with the installation of the last two 100,000-kw units, the capacity was increased to 750 tons per hour and, even now, alterations are contemplated which will increase this still further to 1000 tons per hour.

Two of the five bunkers in the plant each have a storage capacity of 1150 tons, one a capacity of 2500 tons and the last two bunkers that were installed each have a capacity of 960 tons, or a total of 6720 tons. An interruption in the coal supply of

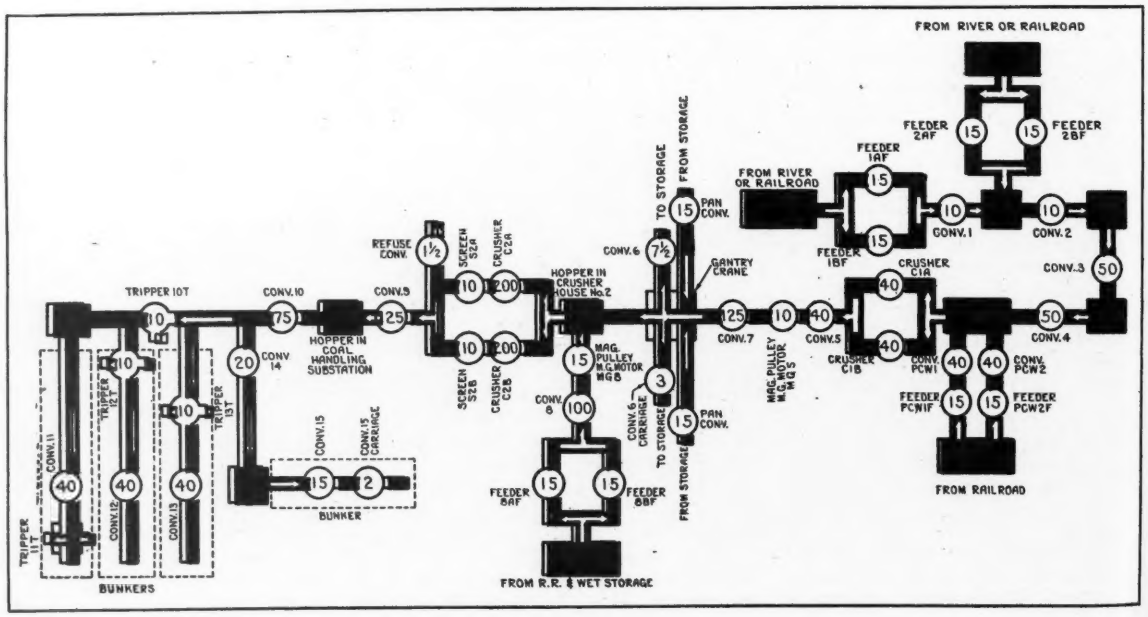


In 1924

Fig. 2. Route diagram of coal-handling system installed at Philo in 1924. Numbers in circles are motor horsepower

Fig. 3. Route diagram of coal-handling system installed at Philo at the present time. Numbers in circles are motor horsepower

Now



room, controlled 10 motors. Now look at Fig. 4, present equipment controlling 32 motors.

Control at Philo . . . . . .

By A. H. BEILER

Electrical Engineering Div., American Gas & Electric Service Corp.

While the capacity of the Philo Station of Ohio Power Co. was being increased 5-fold—from 80,000 kw in 1924 to over 440,000 kw in 1943—the coal-handling system and its control also had to be modernized to keep pace . . . Part I of this two-part article describes in detail the original coal-handling control and its operation to control automatically the original conveyor and crusher motors; at the time, it was the last word in automatic coal-handling control . . . It also shows how the control was simplified when all these motors were changed to full-voltage starting . . . Part II in a future issue will describe in detail the present system using the latest types of control equipment, controlling three times as many motors and occupying less than a quarter of the space of the original control

slightly over twenty-four hours would drain them dry and the plant would have to shut down.

The original conveying system installed in 1924 had six belts and four crushers, arranged in the sequence shown diagrammatically in Fig. 2. Coal was delivered either by barge at the nearby Muskingum River or by railroad. At the river, coal cranes unloaded the barges and dumped the coal into the river hopper. The hopper under the railroad tracks received the rail coal, and rail coal could also be delivered to the river hopper. Two "pan conveyors" carried the coal to Crusher House No. 1 where it was routed through the Crushers, C1A and C1B and then carried by Conveyor 1 to Crusher House No. 2.

En route the coal was—and still is—intercepted by a gantry crane, which can either let it continue on through or dump it to either side into the storage yard. Large fuel consumption requires correspondingly large storage capacity and, at Philo, space is available for about 400,000 tons of coal. On the average, about half of this amount is held in reserve in the storage pile, in case strikes or other emergencies delay normal coal deliveries. The coal is reclaimed by two buckets on the gantry crane, each having a capacity of about 2½ tons, and dumped back on to Conveyor 1 again to continue on into the plant.

At Crusher House No. 1, the coal received an additional crushing and was then carried over Conveyors 2, 3 and 4 to its destination at the bunkers in the plant. A coal tripper, mechanically-operated from Conveyor 4, distributed the coal throughout the length of the bunker.

Six a-c motors for the conveyors, four for the crushers and seven d-c motors for the gantry crane operated the coal handling system. The horse power rating of the a-c motors is indicated by the numbers in the circles on the diagram. The gantry crane had seven 55-hp motors, two for the bucket holding lines, two for the closing lines, two for the trolleys and one for the bridge.

*See Philo Station Establishes Record of Economy, POWER PLANT ENGINEERING, June 1, 1925. Also Philo's New 160,000-kw Unit No. 3 in Service, *Ibid*, September 1, 1929.

Original Electrical Equipment

Power is supplied to all the coal-handling motors over four 2300-v, 3-phase, 60-cycle feeders from the station auxiliary buses. It is stepped down to 440 v through two banks of transformers, each originally rated 450 kva. These supplied the 10 a-c motors. Two synchronous motor-generator sets, each rated 425 hp, 2300 v, a-c to 300 kw, 550 v d-c, supply the gantry crane motors.

All four sides of the control room were required to house the control panels for the coal-handling equipment. These are shown in the photograph, Fig. 1. There were panels for the control of the 2300-v incoming lines, the 2300-440-v transformers, the motors and generators of the conversion sets, the d-c feeders to the gantry crane and, last but far from

Fig. 4. Coal-handling control equipment now in operation at Philo Station. The steel enclosed contactors and circuit breakers directly control 20 motors and indirectly control 12 additional motors. Compare with Fig. 1

For more on "How It Worked," turn the page

least, the automatic control of the ten conveyor and crusher motors. This article will concern itself mainly with the latter equipment and its subsequent development.

The switchboard installed in 1924 was considered the last word in automatic coal handling control. The a-c motors were rated 440 v, 3 phase, 60 cycles, had wound rotors and, dependent on belt length, were started automatically with two, three or four steps of resistance in their rotor circuits. The resistance was short-circuited with accelerating contactors controlled by current limit relays. Each motor was protected by a plunger and oil dash-pot type of overload relay. Operation of this relay would open the coil circuit of the primary contactor and thus stop the overloaded motor.

The automatic accelerating scheme was a masterpiece of ingenuity, now, alas! superseded because of simpler operating methods. Regardless of the number of starting steps, each starting panel had two current-limit relays to control the operation of the accelerating contactors which cut out resistance from the rotor circuit of the motor. First one relay would function, then it would pass on its duties to the second and this in turn would transfer the job to the first relay again, back and forth through a clever arrangement of interlocks.

Automatic Sequence Control

The motors were arranged to start in sequence, to assure that a conveyor was in motion before coal was deposited on it. Thus the conveyors started in sequence from the plant outward to the track hoppers. The closure of the last accelerating contactor of a motor would initiate the closing of the primary contactor of the motor succeeding in the sequence, and this would in turn cause its accelerating contactors to function to cut out rotor resistance under the control of its current limit relays.

Figure 6 is an elementary diagram of the original control scheme where for simplicity the primary and accelerating contactors have been omitted. Starting at the left of the diagram, pressing the master start push button energized the master control relay M from line L-3, provided certain emergency push buttons were closed. These are strategically located at the crushers and along the conveyors and a part or the entire system could be stopped immediately in an emergency by pushing one of these buttons. The return circuit to line L-2 was through two normally-closed interlocks, one on each of the last accelerating contactors of the pan conveyors—the last in the sequence to start and the first to receive coal. The master relay sealed itself in and energized a series of small "interlocking" relays. One such relay was associated with each motor.

The normal sequence of starting was: Crushers C2A, C2B, C1A, C1B, then Conveyors 4, 3, 2, 1, and, lastly, Pan Conveyors PCE and PCW. No interlock relay could close unless the primary contactor of its motor and all the motors following in the sequence were de-energized. This was accomplished through normally closed interlocks on the primary contactors and assured that all these were open before the system could be started up.

The ten interlock relays closed simultaneously as soon as the start button was pressed and the contacts of each closed a circuit to connect the L-2 line to an "under-voltage" relay. The L-3 line of these under-voltage relays was connected to them in the closing sequence, however, through

normally open interlocks on the last accelerating contactor of the motor starting previously in the sequence. The under-voltage relays thus closed one at a time beginning with the one for Crusher C2A and ending with Pan Conveyors PCE and PCW. As soon as the under-voltage relay became energized it sealed itself in on one set of its contacts and closed the respective primary contactor coil circuit (not shown) on a second set. The respective motor would then start and accelerate under automatic control to full speed. When this condition was attained with the closing of the last accelerating contactor, the next under-voltage relay in the sequence would become energized. As soon as each primary contactor closed, its interlock relay would drop out but this had no effect on the under-voltage relay as it had sealed itself in independently.

The closing of the last accelerating contactor on either pan conveyor de-energized the master relay, and this in turn de-energized the last two interlock relays still remaining closed—those belonging to the pan conveyors. Normally all motors would now be running at full speed with all under-voltage, primary and accelerating contactors closed. All interlock re-

Fig. 6. Electrical diagram of the automatic control system originally installed at Philo to control coal-handling system of Fig. 2

LEGEND

P = Primary Contactor.
AC = Accelerating Contactor.
X = Interlock Relay.
UV = Undervoltage Relay.
C1A, C1B, C2A, C2B = Crushers.
PCE, PCW = Pan Conveyors.
PB = Push Button.
CS = "Independent" Control Switches.
L2, L3 = 440 V. Control Lines.
OL = Overcurrent Relay.
UL = Underload Relay.
A, B, C, D, E, F, G = By-Pass Switches.
M = Master Relay.
2LK = Secondary Master Relay.
1, 2, 3, 4 = Belt Conveyors.

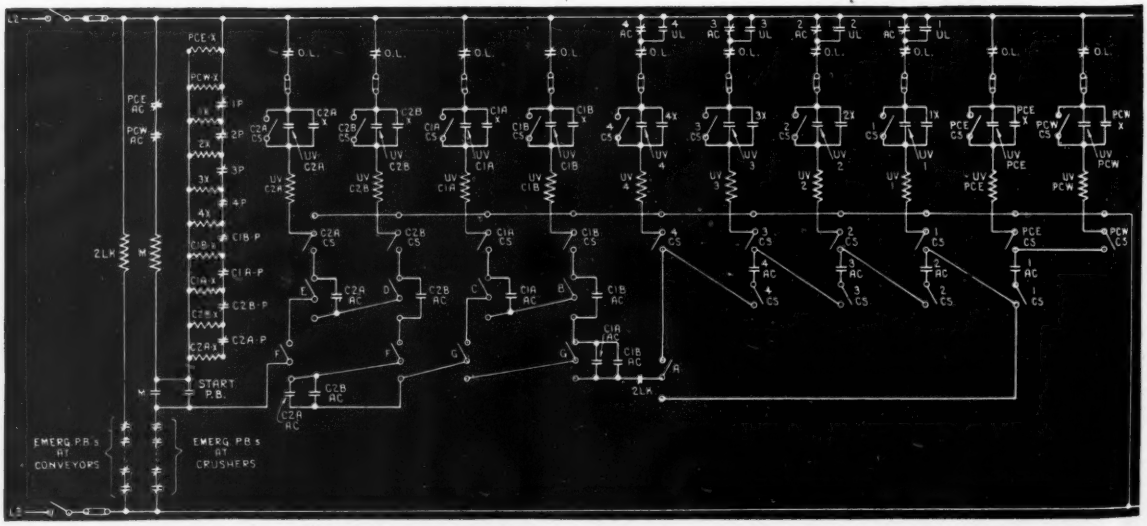


Fig. 5. Coal-handling control panels in January, 1942, after unneeded contactors were removed. The contactors remaining controlled the same motors and provided the same sequence and protective features as the equipment shown in Fig. 1

lays and the master relay were de-energized.

Oviously facilities had to be provided to operate motors independently or to by-pass them when required. Each motor panel had a double-throw knife switch. When moved from its "normal" to the "independent" position the two lines, L-2 and L-3, were connected directly to the under-voltage relay and the corresponding primary contactor then closed and the motor started.

By-passing so that the remainder of the motors could operate required other switches. First there were two D.P.D.T. knife switches, E and F, to by-pass each pair of crusher motors. Then there were four S.P.D.T. knife switches, B, C, D, E, to by-pass the crusher motors individually instead of in pairs. When coal was run to storage, only the pan conveyors, Conveyor 1, and Crushers C1A and C1B, were required. An S.P.D.T. knife switch, A, in its by-pass position, enabled Conveyor 1 to start after the crushers, thus by-passing Conveyors 2, 3 and 4. The pan conveyors would, of course, start after Conveyor 1 was running at full speed.

It was found that stopping the entire system in an emergency often left the crushers choked with coal, which delayed re-starting. The emergency push buttons along the conveyor runs were, therefore, segregated from those at the crushers. The latter buttons stopped the entire system by removing L-3 line potential from all the contactor coils; the former controlled a secondary master relay "2LK" which withheld this line potential from the conveyors only.

The engineers who designed the coal handling system envisioned a number of bogies against which they wanted protection, and the manufacturer of the control panels, always complaisant to a customer, gave it to them. One of these bogies was belt breakage, and to detect it, induction "underload" relays were provided so that if a belt motor decreased its power intake below what it took with an idle belt, as would be the case if a belt broke, this motor and all others following in the sequence shut down. The underload relay contacts controlled the under-voltage relay coil circuit. At starting, it was necessary to by-pass these open contacts by a normally closed interlock on one of the accelerating contactors of the respective motor, but by the time this interlock opened, the motor was already drawing sufficient power so that the underload relay contacts were closed and operation was not interrupted.

1928 Plant Extension

In 1928, when the 3-unit, 160,000 kw turbo-generator was installed, the correspondingly increased coal consumption required additions to the coal handling facilities. The coal handling transformer banks, each rated 450 kva, were replaced by 750 kva banks. The Crushers, C2A and C2B, had their motors changed from 75 to 100 hp and the pan conveyors, theirs from 40 to 75 hp. Two additional Conveyors, 5R and 5L, driven by 40 hp motors together with their belt-operated trippers, were installed in the plant over the bunkers supplying coal to the boilers for the new turbo-generator.

Conveyors 4, 5R and 5L were the ultimate destination of the coal on the conveying system before it dropped into the bunkers, and at least one of these three conveyors had to be operating before the remaining conveyors could be started. Push buttons were locally installed so that the man routing the coal to the respective conveyor could start and stop its motor as required. The remainder of the conveying system functioned automatically as heretofore.

Further Extensions

By 1936, the capacity of the two pan conveyors proved inadequate and two additional pan conveyors were installed. This required the replacing of the two 75-hp motors with four 40-hp motors. Experience had indicated that squirrel-cage motors when started at full voltage would operate satisfactorily on conveyor applications, and this was now tried at Philo. Using the discarded accelerating contactors of the original two wound-rotor motors as the primary contactors of the new motors avoided the purchase of additional control equipment. This was quite important, since no more space was available in the control room. It was also possible to utilize the cable runs going to the rotors of the original motors for the primary cable runs of the new squirrel-cage motors and this avoided the installation of any new cables.

Trouble had also been experienced with tramp iron in the coal which occasionally damaged a conveyor belt, and a magnetic separator was installed to intercept this material. This separator was mounted at a point in the conveying system before the coal reached Conveyor 1. Conveyor 1 was accordingly divided into two conveyors; the additional one was known as Conveyor 1A. It was driven by a 40 hp motor.

At this time, it was decided to dispense with the use of the underload relays, as they had given more trouble than their protection was worth.

In 1941, work was started on the two 100,000 kw turbo-generators and anticipating greatly enlarged coal handling facilities, experiments were undertaken to ascertain to what extent all the wound rotor motors could operate under full-voltage starting. Considerable caution had to be exercised in making this experiment, so as to be certain that none of the motors or conveying equipment would be damaged.

First, one of the smaller motors was selected and one step of its rotor resistance short circuited. Operation was observed over a period of several weeks. Then this was tried progressively on the remainder of the motors without any untoward effects. A second step of resistance was short circuited and then all rotor resistance was cut out on one motor and it started as satisfactorily as before. There were no dead spots, the motor did not overheat, and sufficient torque was available to start the belt. Apparently the original designers of the coal handling system had used large factors of safety in the torque requirements. At last all motors were started without any starting resistance and operation again observed for several weeks. This proved entirely satisfactory and it was, therefore, concluded that it would be safe to eliminate all accelerating contactors and use them where possible for controlling the primary circuit of any new motors which were to be installed. These motors, would, of course, all be squirrel cage machines. It was thus possible to avoid any extensive additions to the control equip-

(Continued on page 130)

HOW TO GET
Efficient Operation and Economy in Piping Systems

By H. J. PETERSEN Head Mechanical Engineer, Tennessee Valley Authority

DURING the past decade the Tennessee Valley Authority has designed sixteen hydroelectric power plants which include almost every type of plant except those using Pelton wheels. These plants were all designed by essentially the same organization, which resulted in a succession of improved designs as experiences gained in the earlier plants were incorporated in the designs of the later plants. This is especially true in the case of the mechanical auxiliaries since considerable latitude is permitted in the design of these systems. Consequently, it has been possible to standardize on a good many features of these auxiliaries which have proved themselves in service.

This paper will discuss the design of the various mechanical auxiliaries for hydroelectric power plants as developed by the Authority, outlining the reasons establishing the designs adopted. It is expected that these designs will be superseded by later and better designs as operating experiences and improved techniques dictate. It is not intended that this paper shall represent a comprehensive treatise on hydroelectric powerplant piping and auxiliaries, as these subjects are well handled in numerous textbooks and manuals; however, the scope of this discussion makes it desirable to complement the specific references to TVA design with a review of certain related principles which the author considers good general piping practice.†

In general, the term "mechanical auxiliaries" includes those systems usually consisting of one or more machines connected by piping to the main prime movers to aid them in their proper functioning, or other systems distributed throughout the powerhouse for services such as water, air, drainage, and so forth. Because they occupy relatively small spaces and usually are located in out-of-the-way places in the powerhouse, these systems sometimes do not receive their full share of attention and may be slighted in the design. In almost all cases they are vital to successful and economical operation, and thought given to their design in the preliminary stages will pay dividends in the long run in the trouble-free operation of the plant.

However, the amount of time and effort spent in the design of these features should be justified by the results required. Elaborate calculations and long complicated empirical and theoretical formulas should be resorted to only when the results prescribed make their use unavoidable. Only a novice will carry out a computation to two or three decimals when a lesser number of significant figures will suffice. An experienced designer is aware of this and has available a number of charts, tables, and curves, from which he is able to pick certain approximate values which facilitate his design. Also, a practical designer will always maintain a close liaison with the department that will operate the plant in order to ascertain its likes and dislikes in the matter of machinery and equipment. Many times that department, because of its operating experiences, can make worthwhile contributions to the design.

Before reviewing the design of the individual systems†, several features common to all systems and on which generalizations may be made will be discussed.

The Fundamental Requirement

The fundamental requirement for any piping system is that it shall be functionally correct. All valves and items of equipment should be in proper relation to each other, so that the system operates in the most efficient manner possible.

The best way to obtain this result is by making a valve-operation diagram. Fig. 1 is such a diagram for a governor and lubricating-oil system at one of the Authority's plants. It will be noted that this diagram outlines the entire system, including all valves, equipment, and machinery. From this it is an easy matter to check the over-all design of the system from a functional standpoint. This diagram, made in sketch form before any drawings are begun, serves as a guide to the draftsman in making the detailed drawings. When made into a final drawing, it has the further purpose of aiding the field erection forces in the installation of the

*Abstracted from paper entitled Design of Mechanical Auxiliaries for TVA Hydroelectric Plants, presented at Spring Meeting ASME, April 1946, Chattanooga, Tenn. To be published in full in ASME Transactions.

†Details of individual systems to appear in later issues.

Fig. 1. Valve operation diagram, governor and lubricating oil system, Fort Loudoun Project. (Units 3 and 4 and some valve numbers omitted for clarity)

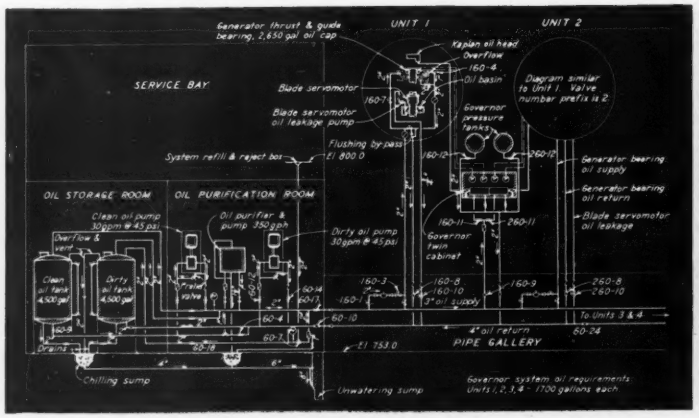
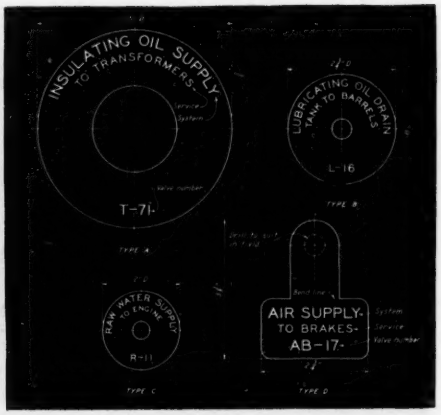


Fig. 2. Typical valve marker tags. Tags A, B and C are attached to the handwheels underneath the nut



To get the first, base the system on a valve-operation diagram showing correct relations of valves and equipment . . . Keep piping and valving simple, provide easy access, consider ultimate requirements . . . To get the second, analyze expected life vs costs; sizes and pumping costs vs investment; operating convenience and reduced maintenance vs cost of getting them . . . These are the fundamental principles of piping and auxiliary system design employed by the TVA engineering staff in designing sixteen hydroelectric plants* . . . Although based on hydro plant practice, these principles apply to many types of power and industrial systems

piping, and finally it enables the operators to visualize the system as a unit which promotes more efficient operation. Each valve on each system is marked with an aluminum tag describing its function (see Fig. 2). Tags A, B, and C are attached to the valve handwheels underneath the nut, while tag D is attached to the valve-bonnet bolt, to the valve stem, or to the operating chain. Each valve is numbered according to a standard system, and an experienced operator can tell the relative location of a valve in the piping system by its number. The symbols shown on this drawing for the various kinds of valves and items of equipment are standard for the diagrams for all plants.

During the preliminary stages of the design of the powerhouse, adequate consideration should be given to the physical location of the pipe lines. It is absolutely essential that all the various systems be considered as a group in order to lay out the space requirements properly. Close co-ordination between the piping designer, the architect, and the concrete designer is essential at this stage of the design in order to insure proper space for pipe galleries, tunnels, and riser shafts.

Typical Examples

Figure 3 shows a gallery containing a number of piping systems. It will be noted that the gallery is of ample size, that all the pipes are racked along the wall parallel to the building lines, and that they provide adequate headroom. As a contrast, one of the earlier designs showing the piping around the top of a shaft is illustrated in Fig. 4. Note the pipe at angles to building walls, the inaccessibility of valves, some valves upside down, and the general appearance of having been designed one system at a time instead of as a group. The improvement in the oil piping shown in Fig. 6, over that shown in Fig. 5, is evident. Figure 5 has large radii bends combined with welding fittings, pipes crossing each other at angles, pipe in more than one plane, and a multiplicity of valves and piping.

By locating the equipment closer to the walls and by using three-way cocks, as shown in Fig. 6 for a similar system in a later powerhouse, it was possible to eliminate many valves and some of the piping. The use of welding fittings throughout and the uniform spacing of the headers result in a piping design which places the accent on simplicity and good appearance as well as functionalism. The choice of the operator between these two designs is obvious.

The greatest part of the steel pipe used by the Authority for hydroelectric plants is purchased under ASTM Specification A 120, standard weight (ASA-B36.10). For certain pipe assemblies where considerable bending or coiling of the pipe is necessary, the pipe is specified as ASTM-A 53, Grade A. Wrought-iron pipe is purchased under ASTM Specification A 72. All cast-iron pipe is bell and spigot centrifugally cast, with class depending upon the pressure. Cast-iron pipe for pressure lines is purchased cement-lined, as it may be had at little or no increase in price, and experience has proved that it is much more resistant to tuberculation. Cast-iron pipe is purchased in 16- or 18-ft lengths, depending upon the supplier. Shorter lengths are seldom used because of the added calking expense.

In some of the larger size mains, it has proved advantageous to use spiral-welded pipe. This is especially true in drainage lines embedded in concrete where the cost of steel or cast-iron pipe would not be justified. Steel pipe is purchased in random lengths with ends threaded and coupled, or beveled for welding, as the case may be. We find that it is cheaper to weld pipes 4 in. and larger than to use screwed flanges. It also saves time and expense to have complicated welding pipe assemblies shop-welded into subassemblies which are then welded together in the field.

The Authority makes single-line detailed construction drawings for piping systems using pipe 2 in. and smaller and for large-scale yard piping of all sizes. They can be made much faster and, except in some congested areas, they gave a satisfactory physical picture. Any congested areas are developed either with standard double-line drawings or by isometric projection. Duplication of views, notations, dimensions, and mark numbers are avoided as they add to design expense and increase chances for error.

Where lines lead directly to headwater or tailwater, heavier construction is used up to the first valve to guard against possible breakage. A special connection is used where embedded lines emerge from the concrete in the various galleries. In smaller lines a screwed coupling is placed flush with the face of the concrete wall; this permits ready replacement in case of breakage in the

(Continued on page 126)

Fig. 3. Design of piping in a gallery. All pipes are racked along the wall parallel to the building lines and they provide adequate headroom

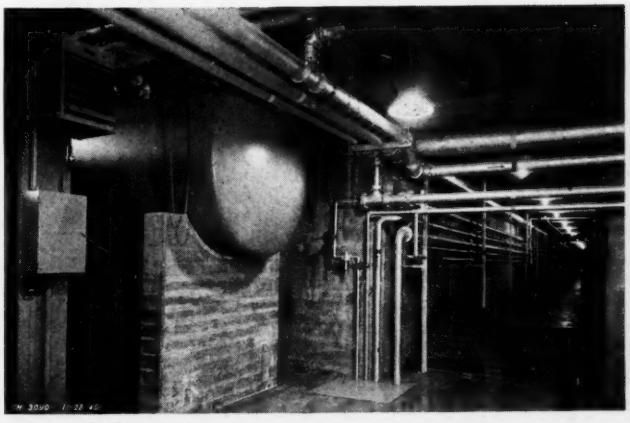
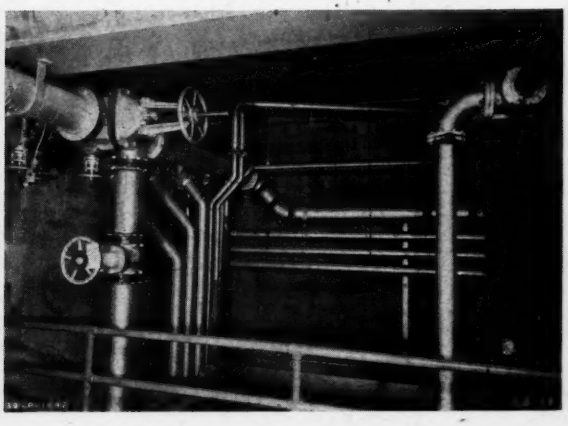


Fig. 4. Piping at top of a shaft. Note contrast with Fig. 3. Piping is at angle to building walls, valves are inaccessible



Reverting to Oil Fuel

Oil burning Scotch marine boilers forced to burn coal on underfeed stokers during war now reconverted to oil . . . Complete shift on one boiler made in 48 hr . . . Flue gas now indicates 12 per cent CO_2 . . . Training program for young engineers started

By Wm. A. Steinbach,

Building Superintendent, Aldens, Inc.

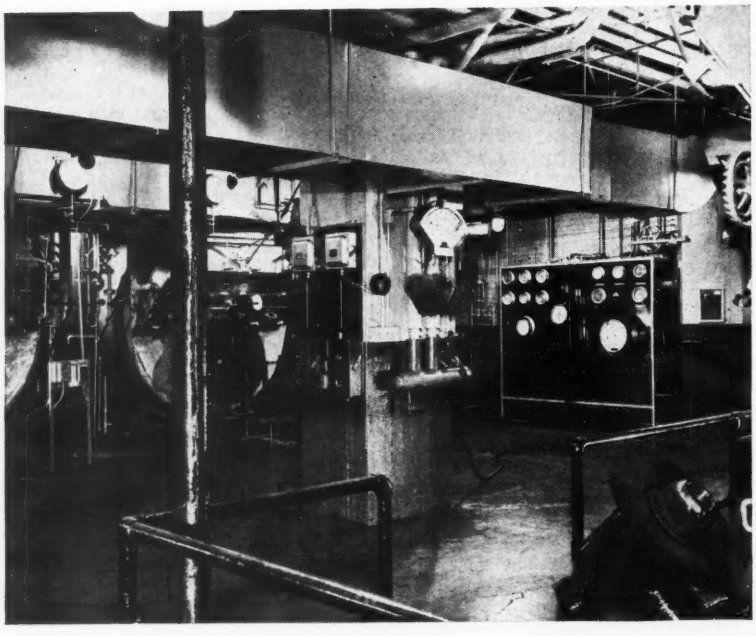


Fig. 1. This view of the boiler room shows the gage and recorder board in the right background while in the lower right hand corner one of the oil burners may be seen tilted back on its base. The four boilers are fired through a firing ring of clay encased in steel with secondary air ports around the entire circle

RECONVERSION at the plant of Aldens, Inc., Chicago, is completed as the underfeed stokers that were used in the Scotch marine boilers during the war emergency are removed and the oil burners put back in service as they were in pre-war days. At the start of the oil shortage during the war, it was decided to burn coal as fuel. Many different types of coal burning equipment were investigated without our being able to install them because the priority on steel would not allow us to build a Dutch oven to use as the combustion chamber. Finally it came to the point where we had to shut down or install an underfeed stoker right in the Morrison tube. This type of stoker was finally installed and used with fair efficiency, but not anywhere near the efficiency or flexibility of our oil burners.

Shortly after V-J Day, with the assurance of obtaining all the oil we needed, the reconversion work was started to put the oil burners back into operation. When the engineers found out that the burners were go-

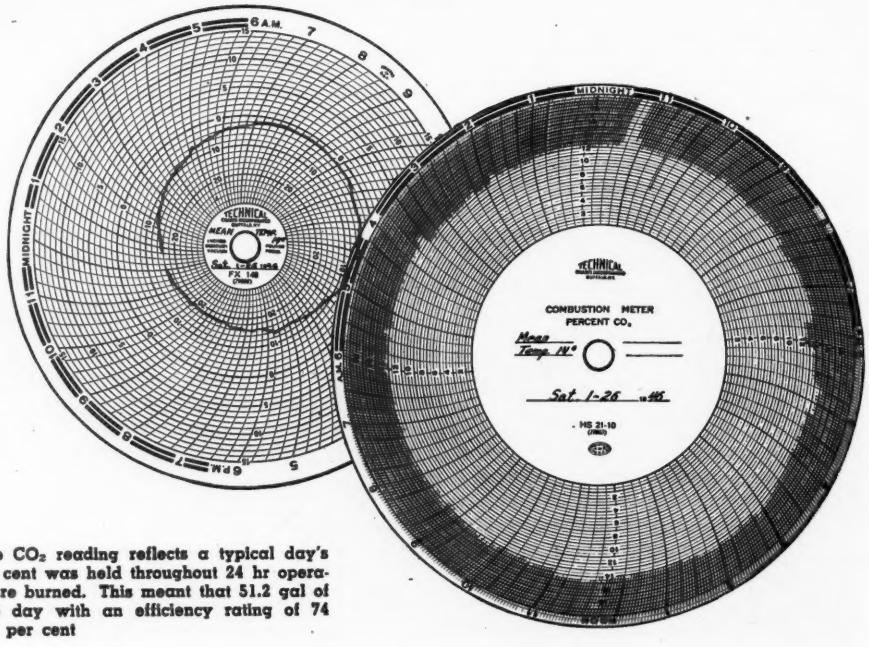


Fig. 2. This chart shows the vacuum on the heating system. The heating system pressure is kept on the vacuum side at all times regardless of how cold the weather may be

Fig. 3. This recording of the CO_2 reading reflects a typical day's operation. More than 12 per cent was held throughout 24 hr operation while 3050 gal of oil were burned. This meant that 51.2 gal of oil were burned per degree day with an efficiency rating of 74 per cent

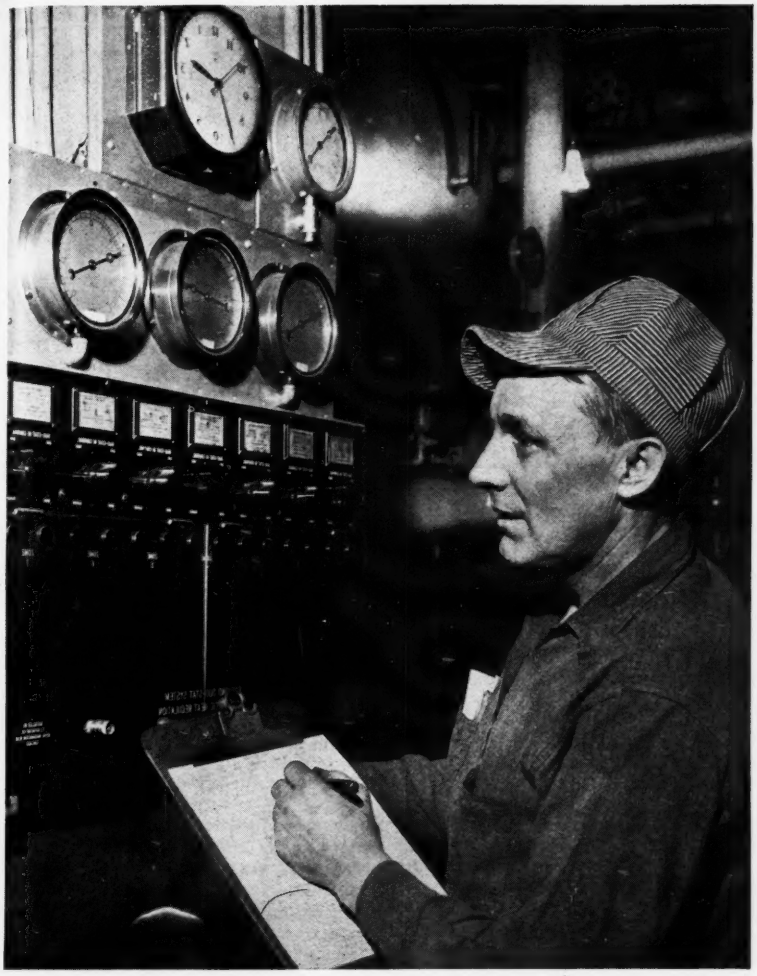


Fig. 4. Chief Engineer 'Tex" Louthan checks the heating system control board which is electrically operated to show which zones are on or off. Control is governed by an outside thermostat in unison with inside temperature

ing to be reinstalled, they really went to work on removing the stokers, the last one being taken out and the oil burner reinstalled in 48 hr, ready to produce steam.

The plant now consists of four Scotch marine boilers, each with its individual oil-burning equipment, fired through a firing ring of fire clay encased in steel with secondary air ports opening around the entire circle; each burner is mounted on a pedestal through which the primary air travels and which can be tilted back away from the firing port making it convenient to clean the cone type tip or make any other changes.

The heating system pressure is kept on the vacuum side at all times regardless of how cold the weather may be, as the chart Fig. 2 shows a differential of 4 to 6 in. with a mean temperature of 14 F; the vacuum at the suction of the steam operated pumps being held at 15 in. The exhaust from these steam operated vacuum pumps is fed into the enclosed feedwater heater which in turn empties the condensate into the hot water heater tanks. A control setup is provided to allow live steam to be put into the hot water heaters when the condensate from the feedwater heater is not sufficient.

Stack temperatures run between 450 and 500 F without visible smoke. Heavy oil is used in daily operation with a Baumé reading of 15 deg; when shutting down, light oil is turned into the lines leading to the burners so that they may be easily started in the morning; then when the combustion chamber is warmed up, the heavy oil is pumped into the feed lines again.

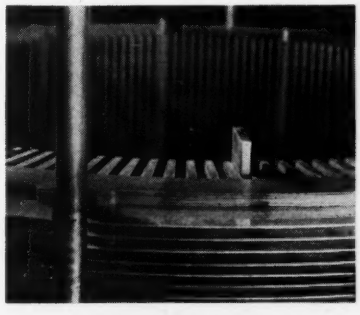
On the day's operation shown in the chart Fig. 3, a CO_2 reading of more than 12 per cent was held, 3050 gal. of oil is burned, because of the extreme cold the boilers were kept going continuously day and night, to heat sprinkler tanks and other essentials, 342,000 lb of water were evaporated, 51.2 gal of oil per degree day were used with an efficiency rating of 74 per cent. This compares with a pre-war efficiency of 76 percent in 1941 and 52.6 gal per degree day using a Baumé oil of 9 deg.

The efficiency of this plant is not only back to pre-war levels but the morale of the operators is also back because of the bright and shining boiler room. As quickly as the coal bin was emptied, the entire boiler room was washed down and repainted, the coal bin being made into a new locker room with all the trimmings of washbowls and shower.

A training program has also been started for the newly hired young veterans who have had limited engineering experience. These men are turned over to our experienced operators of the boiler room to make good stationary engineers out of them for the years to come. Because of the efficiency of this plant layout and the use of oil, enable the carrying of a greater load on the boilers, we are also able to furnish steam to the clothes presses on our merchandise floors, along with furnishing steam to the cafeteria which feeds approximately 4000 people daily.

Copper Sandwich Aids Motor Cooling

A NOVEL method for cooling the stators of large totally-enclosed a-c motors has been developed at the Westinghouse Electric Corporation. It is a simple, but effective thing, and depends on the fact that copper is a ten times better heat conductor than iron. Stator punchings are made of thin copper sheet exactly like the magnetic-iron punchings except that they are about two inches longer at the back. These copper punchings are spaced at intervals with the steel punchings giving, in effect, circular fins projecting beyond the stator iron. Because these copper discs are in intimate contact with the iron, where the heat is generated, they are able to conduct heat to the back of the stator, where it can be removed by the air recirculated by the fan on the



rotor shaft. Because the copper laminations go into the spaces previously occupied by the slots to allow for passage of cooling air the total length of the rotor is actually reduced.

This copper-fin cooling system is particularly applicable to large, totally enclosed, fan-cooled motors where the ratio of exterior surface to volume of iron is small. In small machines the ratio of surface to volume is large.

INTER-C

By L. A. Randall

Sound Equipment Division
Stromberg-Carlson Co.
Rochester, N. Y.

Fig. 1 (above). By means of this microphone the chief engineer can issue orders to all the operators in the plant. All key operators in the plant thus can hear each order at the same time and can make proper adjustments to take care of changed conditions

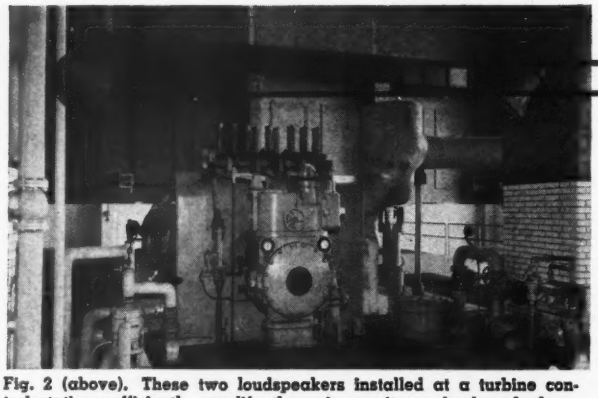
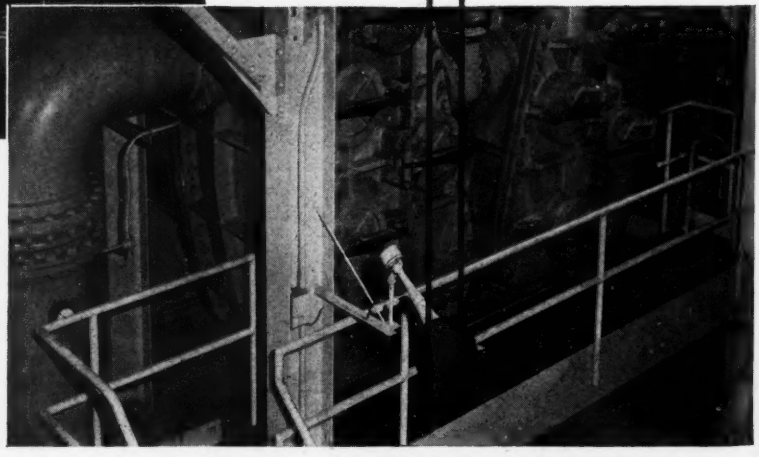


Fig. 2 (above). These two loudspeakers installed at a turbine control station sufficiently amplify the voice so it can be heard above the noise of the equipment. Fig. 3 (below). High powered intercommunication installed in the main electrical control room

DURING recent years, a number of high power intercommunication systems, have been installed in power plants. These systems have been found very useful and valuable to the power plant operators who find them the best means of issuing and receiving orders. Aside from their value in issuing and receiving orders these systems also provide the fastest means of locating roaming personnel, maintenance men and key executives. In times of emergency, these high power intercommunication systems often pay for the cost of their installation in saving equipment from serious damage and in preventing shutdown of plants with resulting loss of production.

The ability of every key operator in the plant to hear every conversation over the system permits these skilled men to make the proper adjustments at their control boards when trouble develops at some other point in the plant.

Fig. 4. The photo below shows how the loudspeaker is installed on the condenser floor; good judgment must be exercised to select the proper type of reproducer to be installed



Design of Inter-communication Systems

Proper number and location of amplifiers must be used to operate speakers at required sound levels

Speakers are grouped and each group wired to individual power amplifier in such a way that failure of one speaker will not render system inoperative.

Reliability of service being of primary importance, 100 per cent spare equipment should be provided

COMMUNICATION System for POWER PLANTS

Developments in the radio and communication fields have made it possible to transmit understandable speech to listener's ears under adverse noise conditions. Because of the high noise level in power plants it has been a problem to communicate intelligence to the operators. The development of high power loudspeaking systems, however, have simplified the solution of this problem and as indicated in this article a number of such loudspeaking systems have been installed in power plants with excellent results. In this article, the author describes these systems and by means of a series of photographs shows how the equipment is installed in modern power stations

In telephone parlance, these high powered intercommunicating systems are common talking. Every conversation taking place over the system is reproduced from all the loudspeakers in the system, except in certain locations when speech is originated at one of these points. A conversation originated at the boiler control board would be heard at the house service pumps, condenser pumps, turbine board, boiler feed pumps, hydrogen control, operators' room, chief engineer's office and every other area where a loudspeaker was located. The reply would also be heard at all speaker locations. Plant operators are therefore fully informed of any changes in routine or difficulties and can govern themselves accordingly.

Due to the peculiar high noise levels in certain areas of a power plant such as the high pitched whine of a generator, good judgment must be exercised to select the proper type of reproducer to be installed in each area. Consideration must be given to the reproducer's ability to cut through the prevailing noise and reproduce clear articulate speech. The audio power handling capacity of the speaker and the electrical audio watts required at the speaker to produce the required intensity or volume of sound is another factor in the design of a satisfactory system. A third requirement in the loudspeaker portion of the system is properly designed line transformers to proportion the correct amounts of audio power from the amplifiers to each speaker. The total number of speakers in a system will vary according to the size of the plant and the quantity of power amplifiers required to drive these speakers at the proper volume levels is determined by the speakers themselves.

At each location where speech is to originate, a microphone is required. Like the number of speakers in a system, the quantity of microphones can be any number desired in accordance with the size of the plant. Reliability in operation is one of the first requisites in a high powered intercommunication system. The microphone should be of the rugged dynamic type. The case should be designed to fit the hand and be sealed against moisture. The microphone should have a treated diaphragm to prevent corrosion and it should be a close talking, low impedance, balanced line model—close talking to prevent blasting when used close to the lips and to assist in excluding the surrounding noise; low impedance because of the long microphone lines to the amplifier; balanced line to reduce noise and hum introduced into the system by the microphone lines. Long microphone cords are required in some locations for flexibility where the operator may be stationed at a control panel with meters and gauges and may desire to walk up and down in front of the panel and announce

Fig. 5. In this view the loudspeaker is installed on a small boiler panel. The microphone is provided with a long cord to give the operator ample opportunity to move around the panel

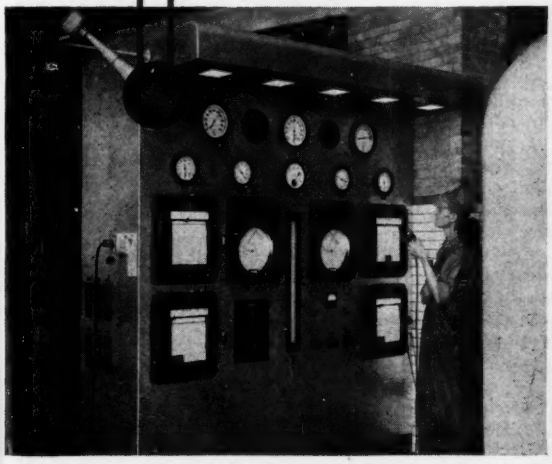


Fig. 6. Here the loudspeaker is installed at the main boiler control board. Again the microphone is attached to a long cord so that the operator can move around to observe the instruments

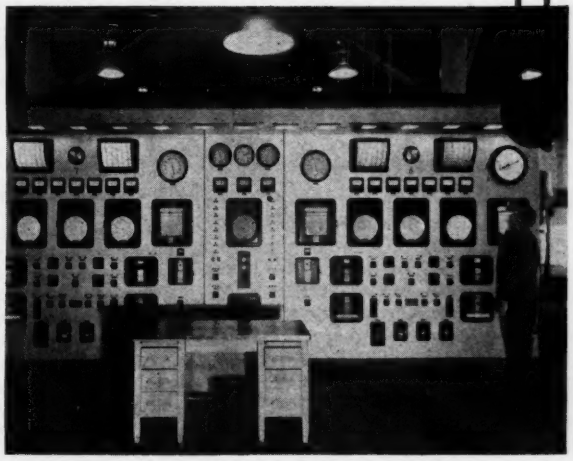


Fig. 7. The photograph above shows an amplifier control board for systems used in power plants. The total number of speakers in a system will vary according to the size of the plant and the number of power amplifiers required to drive the speakers

the various readings or reply to a request for a particular meter reading. Each microphone should incorporate a reliable non-locking switch having refined silver contacts and long life beryllium copper springs. The switch opening in the case should be protected to exclude moisture.

The switch in the microphone head connects the microphone to the input of the amplifier and if the amplifiers are equipped with plate supply cut-off relays, it also operates these relays. In locations where coupling of a microphone and adjacent speaker might occur, the microphone switch when pressed either cuts off the adjacent speaker or reduces the volume to prevent acoustical coupling between these units.

Determining Number of Amplifiers

The quantity of amplifiers required is determined by the audio power needed to operate the speakers at the proper sound levels. Speakers are grouped and each group wired to an individual power amplifier. Failure of a single power amplifier must not make the entire system inoperative. Another precaution against failure of the system is to use a marine type amplifier developed during the war for reliable service under adverse conditions. In addition to its ability to withstand moisture, changes in temperature, etc., the amplifier circuit is designed to minimize tube failure. The pre-amplifier stages are wired in push-pull, output in parallel push-pull and rectifier in parallel. The failure of a single tube in any one stage will result in reduced volume and not in a completely non-operative amplifier. This condition serves as a warning to switch over to the spare equipment.

Reliability in operation being of prime importance, most installations are provided with 100 per cent spare amplifier equipment. The system is so wired and installed that from as many locations in the plant as designated by the plant engineer, a telephone type key in a metal box will actuate relays that switch all microphone and speaker lines from the regular bank of amplifiers to the emergency group of amplifiers.

All amplifiers, switching and control equipment is assembled in steel cabinets.

The war definitely proved that understandable speech can be transmitted from a loudspeaker to a listener's ears under the most adverse noise conditions of a battle. Many lives and ships were saved because the sound system functioned during Naval engagements. No beach landings were made without portable sound equipment that was set up immediately on hitting the beach. Power plant systems can function just as effectively when the correct equipment is selected to do the job.

Engineering Education Award

THIS YEAR, for the first time, an award of $1,000 will be given to the college or university teacher adjudged to have contributed most to the successful teaching of engineering students, it was announced in New York recently by The Society for the Promotion of Engineering Education.

The prize, to be conferred annually, will be known as the George Westinghouse Award in Engineering Education.

In announcing the plan, Dr. Harry S. Rogers, president of the Society and president of the Polytechnic Institute of Brooklyn, made clear that while there are no age limitations in making the award, "consideration will be given especially to the younger men.

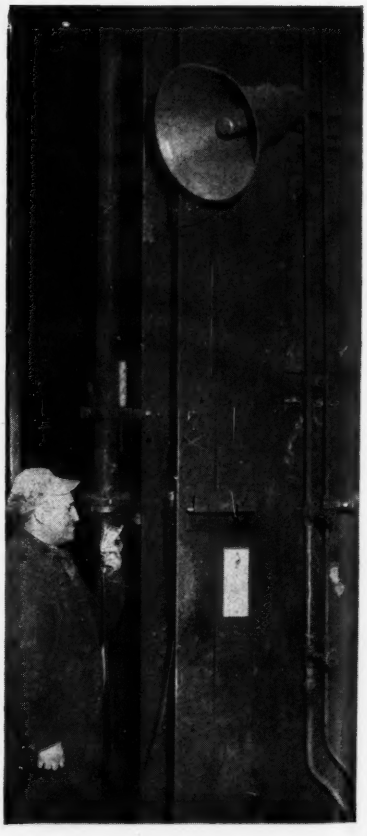


Fig. 8. The picture at the right shows an operator about to use the microphone at a boiler room communication station

Will Your Ball and Roller Bearing Greases Stand Up?

In connection with the manufacture of electrical machinery it often becomes necessary for manufacturers to investigate detail of bearing operation and bearing maintenance. Such investigation often uncovers methods of testing which are of value to the industry at large. This is a particular example of this sort of thing; it represents an investigation made by the General Electric Company on grease testing. The data obtained in this investigation are not only of interest to the manufacturer but to the operator of the equipment as well

By H. A. McConville

THIS TESTING program is proposed as a means of determining the suitability of a grease for ball and roller bearing applications. It involves a performance test on a motor in the laboratory under conditions comparable to those encountered in industry, selecting severe service conditions to accelerate the test. It has been said that many ordinary grades of grease will be satisfactory for about 95 percent of the bearing applications. It is the other 5 percent of bearings which operate under unfavorable conditions such as extremely high speeds, high or low temperatures, etc., that give trouble. The selection of a grease that will give satisfactory lubrication over all ranges of conditions is the aim of most grease consumers. Such a grease is not obtainable, but some greases will have wider ranges than others, and extending their limits is a step towards the ideal sought for.

Laboratory Tests

Laboratory tests for physical and chemical properties can be made which, to some extent, will weed out the least desirable types of greases. No standard method of rating greases is available, and no doubt there will be wide differences of opinion as to what are suitable characteristics.

Before giving a new grease a trial run in a test motor, it is subjected to various tests in the laboratory. These standard tests include A. S. T. M. worked consistency (also a consistency test which is not actually on grease in the unworked condition but in the "as received" state when packed in the test cup with the minimum amount of working), dropping point, soap base, acidity or alkalinity, oil separation or bleeding, and dirt or foreign matter. The significance of these tests to us may be of interest. If the grease is to be applied to the bearings through a pressure fitting by a hand operated pressure gun, its consistency, as received, must not be so stiff that there is trouble in forcing it through the gun. If it is too soft, it may become too thin in operation and leak out of the bearing. The dropping point will aid in identifying the soap base, which determines whether the grease will be good for high temperatures or not; it also is one of the properties that changes with deterioration of the grease. The soap base, in most cases, can be determined by means of flame tests. The measure of free acidity or alkalinity will be an indication of the stability of the grease in service, also its tendency to bleed oil. The presence of free oil in pools in a container of grease is considered very undesirable. The grease must be free from dirt and foreign matter. Methods for making these tests will be found in the appendix.

Test Conditions and Setup

Assuming that the grease has the necessary properties that have proven by past experience to be needed for operation under specific conditions, it is ready for a trial run in a test motor. The motor used in most of the author's tests is a 30 hp. standard induction motor, 3600 rpm, having No. 312 ball bearings in both ends. It has pressure grease fittings for the pressure-relief system. No load is applied during the tests as it is felt that loading will not influence the breakdown of the grease, although it may shorten the life of the bearings. Suitable thermocouples are installed to read the temperature of the outer race of the bearings.

A motor of this size and speed provides more than average severity of service, so that by also increasing the ambient temperature above normal, a 500 hr test will be fairly comparable with a year or more of usual service. It is suggested that the test conditions for a particular service be selected so that the required life under the test conditions will be about 10 percent of the desired service life.

Test Procedure

The suggested test procedure is as follows:

1. Clean bearings and housings thoroughly using a suitable solvent. Do not flush with oil, as the oil film left on the bearing surfaces would affect the test results.

2. Fill the bearings by hand ⅔ full of grease.

3. Run the motor for 500 hr after the bearings have reached the desired temperature, blocking off air circulation if necessary. The bottom drain plug should be removed and left out for 30 min. after the maximum temperature has been attained. This avoids overheating due to expansion of the grease under heat with a resulting increase in pressure.

Examination at Completion of Test

At the end of the 500 hr run, examine the grease in both ends of the motor. To be satisfactory, the following requirements must be met:

A. Bearings shall not become unduly noisy.

B. No noticeable wear on bearing surfaces.

C. No gumming of grease.

D. No free oil collecting in the bottom of the bearing housings.

E. No grease leakage out of the housings.

F. Grease removed substantially free from metal particles.

G. Consistency of grease should not increase (harden) more than a specified percent.

H. Dropping point should not be lower than specified figure.

I. Acid content of grease shall not increase over specified figure.

If the grease passes these requirements, it is then ready to be given a service performance trial in the field in the particular apparatus for which it was intended. Field performance is the only final answer, as many conditions may arise in service which cannot be predicted or duplicated in a laboratory test.

Suggested Limits

The purpose of this paper is to set forth a generally useful test procedure, and not to propose any test limits or standards. However, the test procedure will depend in some degree on the test limits. It, therefore, seems

desirable to give some definite figures arrived at from our experience.

It is felt that for ordinary motor applications, the temperature a grease should stand on the high side is about 90 C (194 F), so the test temperature on the bearings is held at that figure. For higher temperature applications or accelerated tests it should be 100 C (212 F) or 110 C (230 F). 3600 rpm is selected, as many greases will break down in a day's time or less at this speed where they may run for weeks or months at 1800 rpm in the same bearing. A 3600 rpm motor of the size mentioned (No. 312 bearings) is specified because we have found that grease which passes the test in this motor will be satisfactory over a large range of sizes and speeds of bearings. As a caution, however, tests made at 3600 rpm may not duplicate those at 5000 rpm or higher. A special test motor is needed for evaluation at these speeds.

It is realized that 500 hr may not be a long enough period, but many greases will change in a few day's time. It is not proposed to conduct the test to the destruction of the bearings as this makes the test too expensive and time consuming.

Concerning the examination of the grease at the end of the 500 hr period, separation of oil does not exclude small drops of oil which may be scattered through the grease, but does bar greases which leave a pool of free oil in the bottom of the bearing cup. As regards change of consistency of grease in the bearing, the author's belief is that it should not get more than 15 points harder than the original unworked consistency at the beginning of the test. The free acid (calculated as oleic acid) should not be over 1 percent.

The fact must not be overlooked that sometimes samples of greases submitted for test are made in a laboratory on a small scale. These greases may give very good results on the trial run. But when the supplier makes them on a large scale in his grease plant quite often he cannot duplicate his laboratory sample, due either to lack of ingredients which may be hard to obtain or difference in manufacturing technique.

A test setup consisting of a number of bearings running on a shaft which can be heated separately or collectively is not advised, mainly because the grease acts differently in motor bearings. Its action will be different in a bearing with a shaft passing through it from that in one attached to a shaft on one end and fastened on with a nut enclosed by an end bearing cap, as is customary on the end of the motor opposite the coupling end. Grease in this end of the motor will usually become much stiffer. The best check on changes of consistency of a grease is, therefore, made by testing the hardness of the grease in this bearing housing at the end of the test.

Table I

The recommended methods for laboratory measurements of grease properties are largely covered by A. S. T. M. Standards on Petroleum Products and Lubricants listed here.

Worked Consistency — A. S. T. M. Method D217-38T.

Unworked Consistency—A. S. T. M. Method D217-38T.

Dropping Point—A. S. T. M. Method D566-42.

Free Acid or Alkali—A. S. T. M. Method D128-40.

Summary

A test code for evaluation of ball and roller bearing greases is proposed, involving a performance test in a ball bearing motor. Preliminary examination of the grease is made in the laboratory, and some of the undesirable types of grease are eliminated. A standard test motor is described, also a procedure for conducting the test. Interpretation of appearance and physical and chemical changes in the grease at the end of the test run is offered. The proposed test is not the final answer, but is an intermediary step between laboratory physical and chemical tests and long time life tests in apparatus in the field. It is not an attempt to cover the whole field, but is confined to ball bearings operating at speeds below 5000 rpm. Other tests may be proposed later if this type of test proves acceptable to industry.

The soap base will be indicated somewhat by the dropping point of the grease. A check can be made using a flame test. For details of this test consult paper "Identification of Types of Unknown Greases." [1]

If the dirt or foreign matter in grease is to be checked very carefully, the following procedure taken from Government specification AN-G-3a should be followed:

F-5g. Dirt.—Dirt in the grease shall be determined on a sample of known volume, not less than 5 cubic millimeter, which shall be prepared on a clean glass slide in a film approximately 0.15 mm thick, cleared of air bubbles by exposure to 29.30 in. of mercury vacuum for 15 minutes, and then protected from atmospheric dust by a clean cover glass. All particles in the sample 0.001 in. or larger shall be counted under a magnification of at least 60 diameters using a microscope equipped with a calibrated eye-piece micrometer. The control dimensions for all particles shall be the largest dimension except for fibrous inclusions for which the fiber diameter shall be the control dimension. If the sample contains one or more particles larger than 0.005 in. as defined above, a second and third similar sample shall be prepared and examined in the same way. If one or more particles larger than 0.005 in. are discovered in either additional sample, material shall be rejected; but if no such particles appear in either additional sample, the material may be accepted.

[1] Mill and Factory Magazine, Dec., 1944.

Table II

Suggested properties for ball bearing grease for bearings operating at speeds below 5000 rpm.

Worked Consistency—275-295.

Unworked Consistency—265-295.

Dropping Point—150 C (302 F) min.

Free Acid—.1% Max.

Free Alkali—.6% Max.

Soap Base — Sodium-Calcium; Sodium; or Possibly Lithium Combinations.

Corrosion—Grease must not corrode copper alloys or iron or steel.

Saybolt Vicosity of oil at 38 C (100 F) 250-500 sec.

Water Content—.3% Max.

Comparison of Greases Using Suggested Method of Test

A few examples are given here to show what may be expected when this test method is followed. All of these greases meet all of the ordinary laboratory test requirements (Appendix) without difficulty.

Grease A

A ball bearing grease of about 308 worked consistency and a flow point of 332 F. This was put in the test motor and run for 18 days, during 4 of which the temperature of the bearing on the coupling end of the motor was 175 F and on the opposite end was 158 F. At the end of this time, the grease became so thin that most of it leaked out of the housing along the shaft and into the windings. That which was left was very soft and plastered around the balls. This grease was unsuitable as it would leave the bearing almost empty of grease after a few days.

Grease B

A ball bearing grease of about 318 worked consistency and a flow point of 275 F. This grease was run at room temperature in the motor, then the temperature was raised to 175 F and held there for a few hours. The bearing temperature suddenly shot up to 284 F and stayed there for 2 hours when motor was shut down. The test was repeated when the same thing happened and it was decided that this grease would not stand 175 F without breaking down. The grease went very soft but did not leak out, remaining in the bearings.

Grease C

A ball bearing grease of about 274 worked consistency and a flow point of 444 F. This grease was run for 3 weeks in the motor, 2 weeks at 194 F and 1 week at 212 F. At the end of that time its condition was perfect in appearance and it seemed to be operating very satisfactorily. Although it was quite stiff in consistency when cold, after this run, the consistency at operating temperature was very good and the bearing surfaces had a thin film of grease. To the author's mind this grease shows good promise for further field trial.

The
PRACTICAL ENGINEER and ELECTRICIAN
ANDREW W. KRAMER, EDITOR

A Power Show Hits the Road

A modern power show shortly will go on a nationwide tour lasting approximately a year. It will have all the glamor and audience-participation appeal of the old-time medicine show. At the same time it will serve as a much-needed educational medium for the executives and operators and engineers of the hundreds of thousands of small factories who cannot visit installations of new and revolutionary electrical equipment. Westinghouse is putting on the show.

This traveling forum will present a cross section of a modern industrial plant. Seven applications for electric power in industry will be covered. The first deals with adequate wiring. A scale model factory layout is used to demonstrate the advantages of better wiring, power factor correction and the application of circuit breakers.

Section two will deal with resistance welding. Inexperienced members of the audience will be called upon to operate the welder, in order to demonstrate the ease with which it can be used. The other sections of the show will be concerned with lighting, electric furnace brazing, infra-red drying, radio frequency heating and air handling and conditioning.

Perhaps this is the opportunity a lot of engineers have been waiting for . . . maybe they can get the management in their plants to look into the money-saving possibilities of some really up-to-date equipment. The show will be in nearly all the cities in the United States having a concentration of industrial activity. Check with your local utility company: scheduling of the show is to be done through them.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Engineering the Hard Way

Here is another one of those almost heartbreaking accounts of an engineer's experience in trying to put a collection of junk together and make it produce steam. As he explains, the author wrote this narrative after reading Roy Brown's "Engineering by Trial and Error" in the February issue. His account is not as tragic as Mr. Brown's but it involved the same hardship and discouragement. Strangely enough, Mr. Webber feels that the experience gained was well worth the grief he endured

By E. R. WEBBER

"ENGINEERING BY TRIAL AND ERROR," by Roy L. Brown[1] reminds me of an experience somewhat similar which occurred to me several years ago.

Having been employed as shift engineer by a utility company in one of their mid-western stations I was made chief engineer of a less imposing plant owned by the same company in a neighboring city. The transmission line then not having been developed to any great extent each station was on its own without any chance of getting help from its neighbor should trouble develop.

My ambition dominating my better judgment, I accepted the position without a preview. The power plant consisted of three 66 in. by 18 ft hrt boilers with handfired furnaces equipped with two Simplex reciprocating boiler feed pumps and an open feedwater heater. Two of the boilers were in service. In the engine room were two simple Corliss engines each belted to its individual alternator and also a small high speed direct-connected generating unit. The necessary switchboard and belted exciters completed the setup. The leads between the switchboard and machines were not concealed but extended across the floor in wooden troughs.

The man I was to replace having had a better offer was somewhat vexed at my being, as he stated, two days late. He hurriedly showed me around hitting the high spots mainly and then indicated that he wished to visit his home for a few minutes to give some last minute instructions in regards to the crating and packing of his household goods preparatory to moving. That was the last I ever saw of him.

The Grief Begins

It being a 12-hour job and the chief having the day shift I was initiated into my new duties at once. In my short tour of the boiler room I had noticed that the speed of the boiler feed pump seemed to be excessive. I now investigated this and upon feeling the blowoff line which extended behind the boilers I found the answer easily enough. The three inch line was burning hot indicating that the blowoff valves were leaking badly. Checking the supplies I found no repair parts for these valves and so got word to the uptown office advising them to wire for seats and discs at once. The smaller of the Corliss engine units was in operation and along in late afternoon the load increased until it was near the capacity of the generator. The fireman informed me that the other engineer always put on the larger unit for the evening load. Realizing by this time that I had been deserted I knew that I had to work out my own salvation. I proceeded to get the larger unit in motion and with what few tips the fireman could give me, which was not much, I eventually synchronized the two units leaving them both in operation until the night engineer arrived when we proceeded to drop off the smaller machine.

The Number 1 boiler being out of service I removed the blowoff valves and examined the seats and discs but found that they were cut beyond redemption. I attempted to grind them in, however, hoping to improve them somewhat over what they had been. I now decided to put this boiler in service the following day but upon inspecting it above the tubes prior to replacing the manhole plates I received the shock of my life. The scale was so heavy that in places it was bridged across the tubes. I put in the rest of the day in cleaning this boiler and was rewarded by getting nearly a wheelbarrow full of scale out of it. It was still a long way from being clean when I decided to call it a day.

Troubles with a Patch

This boiler in service did not help the blowoff line condition materially but it enabled me to examine the scale situation in another boiler which I found to be fully as serious and meant more hard work. I now received my second shock. It seemed that at sometime previous, Number 1 boiler had been badly bagged and it was not considered expedient to attempt to drive the bag back. A triangular patch had, therefore, been affixed to the sheet over the fire of course. This patch measured 50 in. by 50 in. and was a real source of annoyance. During light load periods when the fire died down somewhat leaks would develop that nearly extinguished the flame. Under opposite conditions when it became necessary to force the boiler the patch would become practically dry. I now proceeded to gather patch experience with a vengeance. As soon as possible I opened and cleaned the third boiler and when the repair parts for the blowoff valves arrived they were installed at the first opportunity. This naturally improved conditions considerably.

During the months following the rivets on the patch were driven up and the sheet caulked so many times that it ceased to do any good. There was no longer anything to draw up on and the rivet heads began to take on the appearance of pants buttons. Of course I had discussed the situation with the local manager on numerous occasions and he in turn had correspondence with the general office on the matter. I would like to say here that the local manager was as fine a man as I ever had occasion to work with and I am certain that if it had not been for the wonderful backing and cooperation that he gave me I would have never weathered the storm. It was also at about this time that I was allowed to engage another engineer to be with me on the day shift which, to say the least, was a lifesaver. Well, to sum the situation up in its entirety the insurance inspector eventually cut the pressure on this Number 1 boiler to a point where we could no longer operate it.

The General Office within a short time advised us that a used Erie City horizontal watertube boiler had been purchased and would be delivered as soon as possible. The company did everything in their power to speed up the installation. The location for the additional boiler was already available in the boiler room without removing any old equipment. In a few days a contract had been awarded for the excavation and building of the necessary foundation and accordingly when the boiler arrived no time was lost in getting it set.

Scale and More Scale

Meanwhile we were operating with the two remaining boilers both being required to carry the load at least 16 hours out of every twenty-four. The following procedure was agreed upon and carried out. Each boiler was opened once every week. As soon as the evening load permitted (usually around ten p m) the boiler to be cleaned was taken off the line, the fire pulled and the cooling off process

[1] Power Plant Engineering, Feb., 1946, page 90.

started. It would be filled with water averaging 208 F in temperature and blown down repeatedly until the pressure was brought to zero when it was drained and the bottom manhole plate removed. Usually a collection of scale and mud would be found on the sheet directly over the grates. I had a variety of hooks and chisels made from ½ in. iron rod with which I proceeded to work on the tubes through the manhole. After loosening what scale could be reached a long hoe was used to pull everything forward where it could be removed and thereafter the boiler was given a good washing, the plate replaced and the boiler refilled. If need be a hoe was used to remove flyash from the combustion chamber. It was at about this time that I usually repaired homeward to get a few hours sleep before reporting back in the morning. The firing up and cutting into service was left to the night crew.

Tubes Rolled After Cleaning

After several weeks of this kind of operation such an accumulation of scale built up on the back heads that the tubes began leaking badly in the heads and it became necessary to roll and bead tubes after each cleaning period. Planks would be laid in the combustion chamber to stand on while doing this work and I have had them catch fire while I was on them. This situation, naturally, slowed up the whole procedure. I especially remember one instance when it was nearly 8 a m before the boiler could be cut into service. Our morning load came on with unusual ferocity and it was next to impossible to hold the steam pressure with one boiler. I hung a weight on the governor of the Corliss engine in service thereby increasing the speed. This naturally caused an earlier cutoff which got us by until we could get the other boiler on the line. Remember, of course, that this was before the days of Telechron clocks.

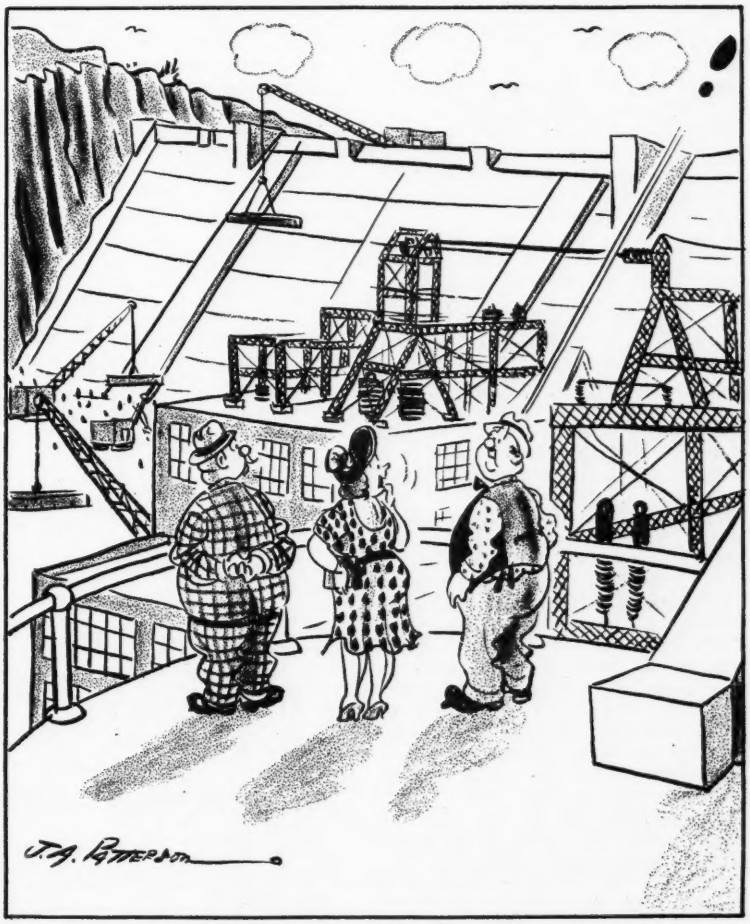
Finally the setting and fitting of the Erie City boiler neared completion. When the job of fitting the handplates was started it was discovered the ⅝ instead of ½ in. gaskets had been supplied. Our supervising engineer was on the job at this time trying to rush the construction and he at once stopped the plate job saying it would be foolhardy to try to use the narrow gaskets as there would be a probability of their blowing out due to their lack of bearing surface. No doubt he was right but I felt that the boiler should be put in service in spite of this obstacle and proceeded to use every argument at my command to put it across. The local manager finally decided the issue by questioning me as to why I was so anxious to get the boiler in service. I replied that it was just one of my hunches. Having had occasion to be in on some hunches I had had previously he gave his approval to get the boiler ready. The plates were therefore put in with the gaskets on hand, the boiler filled and a slow fire started on Tuesday, and on Saturday it was cut onto the line. The other two boilers were carried on a backed fire for safety first until the evening load was past when they were taken off the line and killed. On Monday morning following while cleaning the grates under these boilers it was discovered that they were both bagged.

In due time the Number 1 boiler was replaced with a new unit of the same type and size enabling us to operate the three hrt boilers while cleaning the Erie City and vice versa. They were never fired more than one week without cleaning.

Water Treatment

The reader will probably be wondering by this time what source of water supply we had. It came from artesian wells and contained 36 grains of hardness to the gallon. Having a high percentage of calcium sulphate the scale adhering to the boiler surfaces was hard and flinty and very difficult to remove. The fact that we were operating non-condensing and consequently required 100 per cent makeup caused our scale conditions to be that much more severe. We used a feedwater treatment made up especially to meet our conditions and during the heavy load seasons such large amounts of it were required that it cost us in excess of one hundred dollars monthly. Nevertheless without this compound I doubt very much if it would have been possible to have kept our boilers in operation. It was not only necessary to clean the boilers after each week's operation but in the same length of time the open feedwater heater would become so badly fouled with scale and mud as to often make it necessary to bypass the feedwater to supply the demand of the boiler feed pumps.

In closing I can truthfully say that my first few years in this plant were anything but monotonous. A change of owners, however, eventually gave us a more up-to-date setup influenced by the installation of such luxuries as water softeners, centrifugal pumps and Diesel Engines. This made the last years of my sojourn much more enjoyable and less nerve wracking. In looking back on my first years as chief, however, I cannot help but feel that the experience gained was well worth the grief I endured.



"My! My! It's wonderful how you could get so many beavers together to build such a beautiful dam."

A SPECTACULAR RIGGING OPERATION

The rigging operation here is somewhat removed from the field of power plant operation but it is of such interest to any practical engineer that we present it here. It has to do with the erection of a large gas holder and it is possible that some who read this may have occasion to handle heavy equipment in a somewhat similar manner. The principle set forth by the author should be applicable in jobs of a similar nature

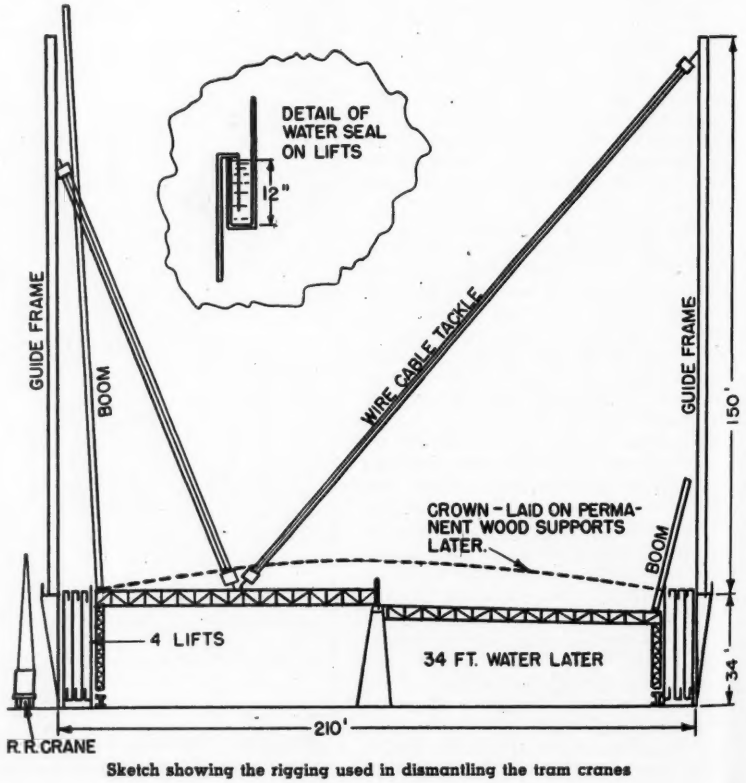
By H. B. McDERMID

NOT MANY TRADES can beat the typical bridgeman, in daring, resourcefulness and ingenuity, when it comes to the job of cutting costs on his work—that of erecting steel. The foreman who does not have these characteristics developed to a high degree does not last long in the race of speed which is daily seen in steel erection. It is the purpose of this story to try to bring one spectacular example of daring rigging to some who do not so often have the chance to observe such work in their daily routine.

To easily grasp the story, one needs to have a fair understanding of the setting of the huge gas holder which this job involved. This particular holder was some 210 ft in diameter, about 180 ft high, and carried some 34,000 tons of water in the 34 ft high tank at its base. It had a gas capacity slightly in excess of four million cubic feet. In erecting it the bottom was first riveted up on horses about three feet off the ground, after which it was lowered to its final resting place on the foundation with several carloads of neat cement serving as grout in which to bed the rivet heads. Next, a center tower, with a big steel pin in its top was erected, and centering on it, two tram cranes with lattice girders more than one hundred feet long, their outer ends carried on trucks running on railroad rails bent to the circle of the tank. These outer ends of these tram cranes were completed by booms, one short one to serve only the walls of the 34-ft water tank and the thin walls of the gas tank, or "lifts," during the process of erection, and the other, towering some two hundred feet in the air, to serve the heavy work on the guide frame in placing the heavy columns which form its main members, necessary to guide the gas chamber up and down during its travel as it is alternately filled and emptied when in service. These tram cranes were set one below the other, so each could cover the entire area of the holder, each entirely independent, except that they could not pass each other, their outer ends being carried on the same circular track set close inside the tank sides. The water tank sides were placed first starting with 1½ in. thick sheets for the first row and gradually decreasing in thickness till the last sheet at the "walk around" was ¾ in. only. This walk set on heavy buttress columns which in turn supported the heavy columns of the guide frame. However, when the water tank sides were completed, the small crane could start placing the sides of the lifts in their lowered position, which set just inside the water tank walls, while the big tram started placing the heavy members of the guide frame above. Thus both cranes could keep busy, and they finished their jobs at about the same time. The next job was the placing of the "crown support" of permanent wooden trusses on which the steel crown or top of the inner "lift" was to be laid and to do that the trams had to be dismantled and gotten out of the way.

The lattice girders forming the longitudinal frame of these cranes were each more than 100 ft long and about six feet square in section, and formed the greatest problem in dismantling. The booms they carried ran close to the high guide frame, and so were comparatively easy to handle, as tackles could be rigged almost anywhere above to dismantle them, but the girders were largely out in the center of the holder with seemingly no advantageous point from which to handle them and their dismantling had always been a slow nightmare to each foreman. This time this foreman studied the layout and came up with a new and daring solution.

Picking one spot near where his railroad crane just outside the holder served the storage yard and as much of the erection job as it could reach, he hung a set of triple wire rope blocks on the inside of the guide frame some 50 ft above the tram girders, attaching its lower end to the girder at a point near its balance; another similar set of tackles he placed directly across the 210 ft holder, up close to the top of the 180 ft guide frame, with its lower block also attached to the tram girder near the first tackle block. Taking up slack in both tackles left him now free to dismantle the outer supports of the tram crane, and leave the steel legs leaning up against the tank sides, to be picked up later. Now he pulled up gently on his tram girder until the inner end came free from its center supporting pin, get-



Sketch showing the rigging used in dismantling the tram cranes

ting exact balance necessary by loading the girder with bridgemen, active as cats and as fearless as anything that walks; now instructing his engineer on the hoist to hoist on his short tackle and slack off on his long one, he soon had the girder worked out through the guide frame of the holder, with all the weight hanging on the short tackle. The next detail was to cut loose his long tackle, now finished, and attach the hook from his railroad crane and then after taking the load on his railroad crane, to cut loose his short tackle, and ease the girder out from its place, and lower it the 35 ft to the yard, there to be dismantled into shipping lengths. The second girder was gotten out by exactly the same process, both in quick time so that the entire job of dismantling and loading out for shipment, took only one eight hour day instead of the three usually taken by other and less able foremen.

The basic system used is not uncommon, that of moving a load sidewise by working it between two tackles, but the large dimensions made it a highly spectacular and unusual method of handling the job, one not to be tackled by a foreman not possessing both nerve and skill, and withal, considerable imagination. See sectional sketch.

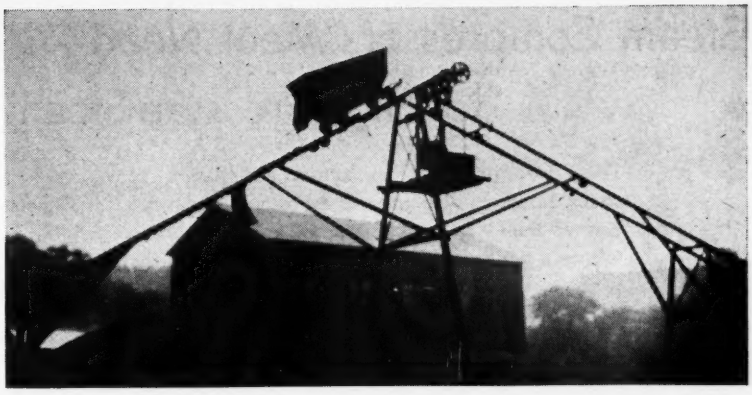


Fig. 2. Tail gate latch of ash car is tripped and ashes fall in neat pile

All Welded Ash Disposal System for Boiler Plant

WHEN HENRY LEOPOLD, Superintendent of an extract company in Tennessee felt that he needed a really effective ash disposal system for the power plant, he exercised his ingenuity and with material easily at hand, built himself such a system. At the time new equipment was hard to get and the arrangement he finally built quickly disposes the ashes from the boiler plant, cheaply and automatically.

As will be seen from the accompanying diagram and photographic illustrations, the system is quite simple. The entire structure was electrically welded and was made from salvage material. Old railroad rails become track and columns and the struts and braces were made from used 4-in. boiler tubes. No bolts were used with the exception of shaft bearings and for bolting down the reduction gear and 5-hp motor.

This system is fully automatic, in that the car ascends the railroad track to the top of the tower, where the tail gate latch is tripped and the ashes unloaded. An automatic switch then reverses the motor and the car returns to the basement boiler room for another load of ashes. As an added safety feature, there is a manual operated switch installed at each end of the system to stop the car at any determined point of travel.

There are two ½ in. closed link chains attached to the car. These chains run up to the top of the tower, over and around the traction sheave, and down to the counter weight car to which they are secured. As the ash car ascends, the counter weight car descends, and vice versa.

The ash car holds one and a half cubic yards of ashes and is doing a very good job of disposing of the ashes in this power plant, which has a coal consumption of 130 tons a day.

(Data and photos, courtesy The Hobart Brothers Company, Troy, Ohio.)

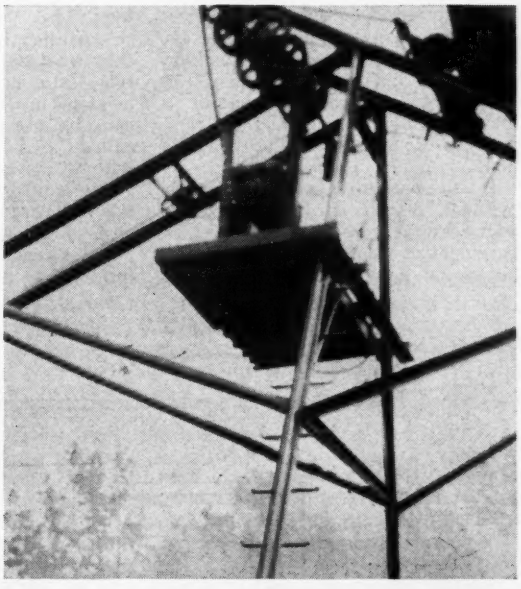


Fig. 3. Close up view of center tower showing gearing and counter weight car

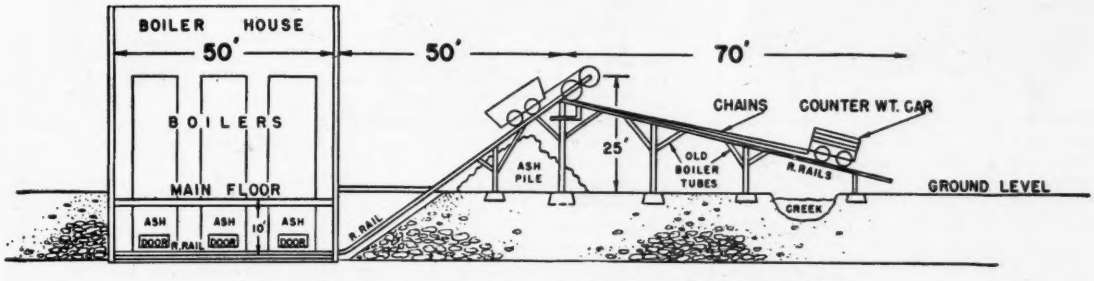


Fig. 1. Sketch of ash disposal system built complete by arc welding

Steam Compressors Meet Need for High Pressure Steam

This description of an actual installation of steam boosters or compressors may suggest the use of this type of equipment in other cases where a limited quantity of high pressure steam is required

By C. G. TURGISS

Chief Engineer, U. S. Rubber Co., Lowell, Massachusetts

WHEN THE PLANT with which the author is associated was converted from the manufacture of 50 caliber ammunition to insulated communication wire, it became necessary to have a supply of 300 lb pressure steam. The boiler pressure at that time was 115 lb and since new high pressure boilers could not be obtained it was decided to use steam compressors to produce the high pressure steam needed for the new manufacturing processes.

Steam compressors are not new. They have been used to a limited extent for many years but their use is still uncommon enough to warrant this description of the installation at this plant. This article describes the compressors or boosters, the auxiliary equipment and the operation of this equipment. A steam compressor is usually a slightly modified air compressor. It raises the pressure of air.

In this particular case, four single cylinder, double-acting horizontal compressors were installed in the basement of what is known as Building No. 2. Each of these compressors was direct connected to a 125 hp synchronous motor which drove it at 277 rpm.

As already mentioned the boilers generated steam at a pressure of 115 lb. This was supplied through an 8-in. main, the latter being equipped with the following valves from the boiler. A pressure reducing valve, set at 65 lb, a 2-in. manually controlled by-pass valve, and a Foxboro Stabilflow valve. These valves discharged into a 12-in. main which acted as a reservoir. The boosters discharged into another 12-in. main or reservoir, and then to two high pressure steam receivers, 48-in. diameter by 10 ft long.

The high pressure steam piping then went up to the second floor into two 12-in. headers, and from these headers to 18 continuous wire vulcanizing machines, or as they were called C.V.'s. Each C.V. was equipped with a Taylor Fulscope Controller which controlled a Taylor Moto-steel valve. There was a by-pass around each of the Moto-steel valves.

The Foxboro Stabilflow valves were installed as follows: Number 1 on the steam supply line and number 2 on a tee on the high pressure steam line ahead of the steam receivers. These two valves were controlled by a Foxboro Stabilog controller. There were also on each booster two Adsco solenoid valves operated by Mercoid pressure control switches.

Compressed air at 100 psi was supplied to these controls, and was reduced to 17 psi at each instrument for control purposes. The Adsco valves required 100 psi air pressure.

De-superheating was accomplished by means of steam driven duplex pump. This pump had 4-in. steam pistons, 1¾ in. water pistons, and a 5-in. stroke. Steam to operate this pump was taken from a 115 lb main. The discharge from the pump was to a jet installed in the high pressure pipe just before it entered the steam receivers. Condensate from the steam jockets of the C.V.'s went to a horizontal flash tank hung from the ceiling of the first floor, then to the suction pipe of pump. If there was deficiency of condensate, make up was supplied from a domestic hot water tank in the same building. A float control valve on flash tank maintained a constant level of water and flash tank was vented to the atmosphere. This pump was manually controlled by a throttle valve and steam temperature maintained according to speed at which pump was operated.

Operation

Compressed air is turned on to all the controls. The hand operated free blow valve on bottom of high pressure discharge is partially opened. The Foxboro controller is set for 250 lb and the Adsco solenoid valves set for 265 lb and 275 lb. Next the steam supply valve and discharge valve are opened slightly. The booster or com-

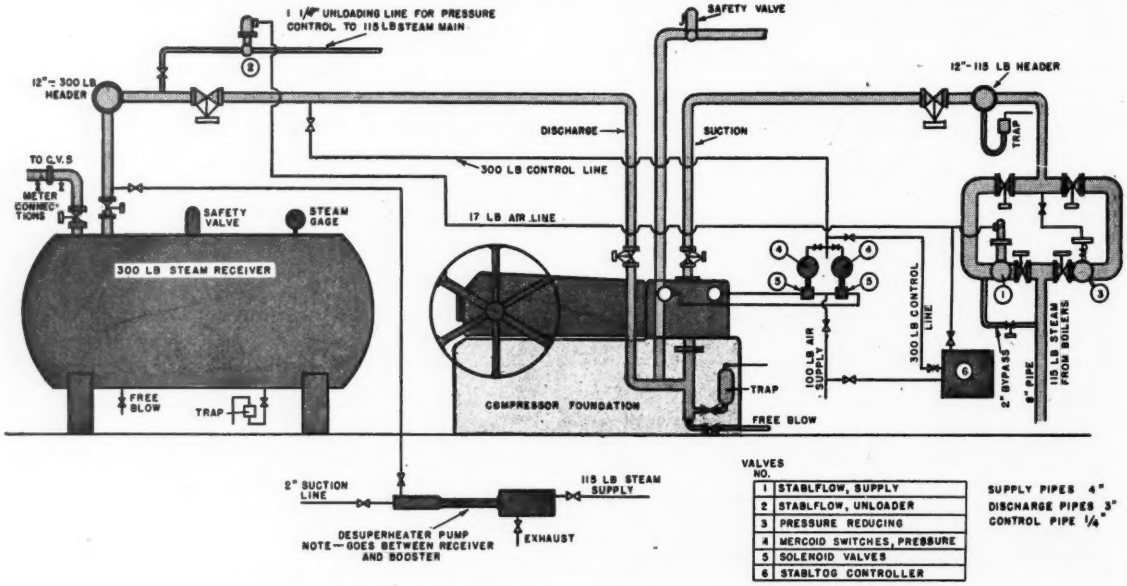


Diagram showing the steam compressors and the associated auxiliaries and piping

pressor is then warmed up, just as a slide valve engine should be.

After the booster has been warmed up thoroughly all the supply and discharge valves are opened wide. The free blow valve is also opened wide. The current is then applied to the motor and booster is brought up to operating speed. The starting circuit holds the unloader valves open on both ends by means of the solenoid valves until the booster reaches operating speed. When this speed is reached the unloader valves close and free blow valve is closed. The booster begins to compress steam up to desired pressure. As the pressure nears 250 lb the Stabilog controller starts to close the Stabilflow valve, and thus throttle the steam supply to the booster. If steam demand is low this valve will close tight. The pressure reducing valve will maintain 65 lb to the suction side of the booster if this does happen. If the steam demand is low, number 2 Stabilflow valve on the high pressure discharge will open and will bleed as much as 1000 lb of steam per hour into a 115 lb steam main for process steam in another part of the building. In the event that any of the Foxboro controllers are disconnected or become inoperative, the Mercoid pressure switches will, when the pressure reaches 265 lb and 275 lb, operate the solenoid valves. These solenoid valves then open the booster unloader valves on either or both ends similar to air compressor unloading.

The Foxboro valves controlled pressures so well within 1½ lb either way, that the Taylor valves were only used when experimenting with lower pressures. The Taylor valves could and did hold the pressures just as close as the Foxboro valves, but in order to prevent the machine operators from using other than predetermined pressures, desired by the Technical Department, the Taylor valves were bypassed, but not disconnected.

A Bailey recording and integrating flow meter was connected in the high pressure line after the steam receivers to record steam pressure, rate of flow, and temperature.

Needless to say, all points where steam could condense were trapped, and each booster had a safety valve between the booster and first discharge stop valve. Each steam receiver had two safety valves.

The discharge from all these safety valves was piped to the outside of the building, and all precautions taken so that in the event that they blew nobody would be burned or scalded.

These compressors were operated for approximately fifteen months, until the Government cancelled the contract.

During this time a new set of piston rings was installed in each booster. Bearings had to be taken up occasionally. Our main job was cleannig carbon from the valves as they carboned rather badly.

Practically all of the credit for the success of this booster operation must be given to the men who ran the boosters; as they took great pride in their work; operators are seldom given credit for doing their job efficiently.

Steam Booster Equipment

FOUR COMPRESSORS
Chicago Pneumatic Tool Company
Size 8½ in. bore by 13 in. stroke
Type TE

FOUR MOTORS
General Electric Company
Directly connected to compressors
Synchronous motor
Type T.S.—HP 125—RPM 277—Volts 440—Amps. Arm 131 PF kv-a. 1.0 100
Cycles 60 Phase 3
Excitation volage 230 Amps fld. 16.5

DE-SUPERHEATER PUMP
Dean Brothers Pump Company
Indianapolis, Indiana
Size 4 in. by 1¾ in. by 5 in.

PRESSURE REDUCING VALVE
Macaleer Valve Company
115 lb to 6 lb

STEAM TRAPS
Armstrong Machine Company

SAFETY VALVES
Ashton superheated steam type

CONTROLS
Foxboro Stabilog Controller and Stabilflow valves

BAILEY METER
Recording and integrating type pressure—temperature-rate of flow

Reduction of Noise in the Power House

By N. T. PEF

NOISE is objectionable no matter where it is found for it is recognized that it is detrimental to whatever one is doing in that it detracts attention and is annoying. In the power house, in addition to being a nuisance, noise can be the cause of serious accidents since it obscures the normal sounds of rotating machinery to which the trained ear is accustomed and knows by the familiar hum that all is well. When a bearing becomes dry or lose, or a pump overspeeds, a belt slips or any other abnormal condition begins to develop, the experienced operator can detect the note of disharmony. But noise can make such detection hard or impossible.

In what follows I shall enumerate some of the kinds of equipment which I have found in my experience as producers of objectionable noise in power houses and shall give my opinion how these noises can be eliminated or reduced.

Pressure reducing valves as a rule are producers of loud and objectionable noise. The average steam pressure reducing valve is so noisy that conversation cannot be heard within 25 ft and sometimes the noise is annoying 50 ft from the valve. This noise can be somewhat reduced by two or more valves in series, that is, reduce the pressure in steps. Another way of helping the situation is by installing the reducing valve or valves as far way from the operating floor as possible. But the surest way to do away with this kind of noise is to do away with the reducing valve.

This can be done by installing in place of the reducing valve a turbine driven house generating set to swing on the line and take load in proportion to the reduced pressure steam demand. This is not a new innovation and is used quite often when it is economically justified. But heretofore the economic justification was based entirely on fuel saved versus amortization of capital investment. The cost of noise cannot be evaluated in dollars and cents but it is there and may be several times the capital investment necessary to eliminate the steam pressure reducing valve by installing in its place a steam driven generator.

Here is another way which can be used where the electric load rules out the use of the house generating set. Have one of the turbine driven feed pumps swing on the line in proportion to the demand for reduced pressure steam and let the other feed pump take care of the variation of feedwater demand. I do not know of a single installation where this combination is in use but it seems to me entirely feasible. Such arrangement, aside from its value of eliminating noise will produce savings in fuel in proportion to its load and can serve as a spare unit for in emergency it can take the place of the regular feed pump while a bypass is used for reducing steam pressure requirements.

And here is a tip to the manufacturers of steam pressure reducing valves and to those with an inventive turn of mind. Why not produce a reducing valve that is noiseless. In the steam turbine the expansion takes place without any noise because of the baffle effect of the blades which keep down the velocity of the steam. It should be possible to construct a noiseless steam pressure reducing valve utilizing this principle.

A second source of noise in the power plant which I have found objectionable are high pressure steam vents. For instance the vents on the boilers which should remain open while the boiler is being put on the line. The noise produced by these vents is so painful that many operators pinch them down or close them entirely rather than endure the annoyance although in so doing they take the chance of burnnig the superheater or doing other damage in not keeping the vent open. This noise can be eliminated by extending the vent line to the outside of the building. Connecting the vent line to the escape pipes of the safety valves does not

reduce the noise to any appreciable extent. The vent line must be run individually to the outside so that the expansion will take place there.

A third source of noise are high speed machines such as fans or centrifugal pumps. Feed pumps lower than 3000 rpm as a rule do not produce objectionable noise but fans can be noisy at that or lower speed because of their greater peripheral velocity. The way to eliminate noise of this type is to select machines of lower speed even at the sacrifice of greater capital investment or to place the noisy machine as far away from the operating floor as possible.

In many cases forced draft fans are placed on the operating floor because that provides the shortest duct work. Forced draft fans as a rule are noisy and they should be installed remote from the operating floor on that account alone. A good place for them is the top floor of the boiler room. Here not only their noise making will not be an annoyance but they will serve the dual good purpose as ventilating fans.

As every one knows at the top of the boilers it is always hot and during the summer months it is oppressively hot if the space is not well ventilated. A forced draft fan here not only will have ventilation value but also save enough fuel to pay for the extra length of duct.

Though I know of many boiler rooms where at the top of the boilers the air temperature is 125 deg. F while at the operating floor it is 75 and less, I will make estimates at a temperature difference of 10 deg. F. In round conservative figures, 10 deg. in air temperature means 0.25 per cent fuel saving. In boiler room with a steam capacity of 100,000 lb per hr, the yearly steam output is 876,000,000 lb, the coal consumption 87,600,000 lb or 43,800 tons, and the fuel bill $160,000 per year. One fourth of one per cent of this is $400 and taking the life of a duct at 20 years, we have $8000 which is enough to pay for a lot of duct work. So that, if the forced draft fan is placed on the top floor instead the operating floor, not only it will pay many times over for the extra duct work but also will do away with noise and have a ventilating value.

There are other sources of noise such as pulverizers, ash evacuators, etc. Some are noisier than others and in making a selection it is well to consider the noise making properties of a machine. It will pay.

Safety Aspects of Power Equipment Shown by Slide Films

By LYNE S. METCALFE

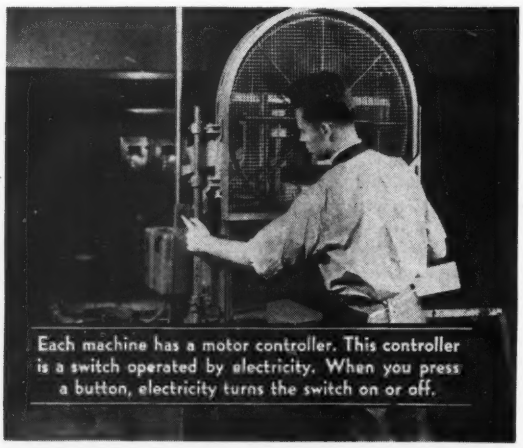
NUMEROUS FILMS of all types have been produced for safety education in recent years, many of them of use to the power plant, and its various departments.

The newest in this field is a series of 8 slide-films dealing with basic safety procedures in the handling of switches, power machinery, etc. The series also includes subjects covering proper on-the-spot procedures in treatment and handling after an accident has happened.

One of the most interesting and useful subjects to the power plant management or educational director is the film in this series dealing with the *power supply*. It shows proper methods of using power switches including those in the power plant's workshops. Other subjects are:

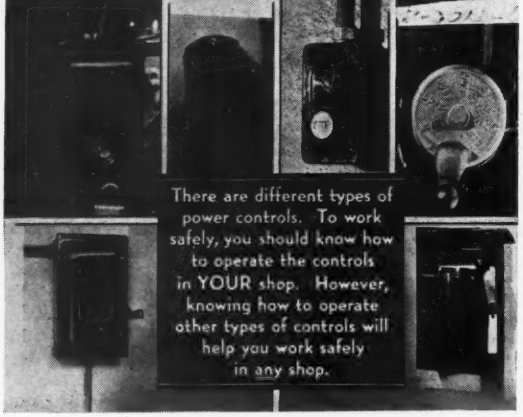
1. Play Safe, Work Safely
2. Maintaining a Safe Shop
3. Safety Inspection
4. Training for Emergencies
5. Treatment for Bleeding, Shock, etc.
6. Aid for Injuries
7. Eye Protection
8. Power Supply

This type of film is a strip of 35 mm. safety motion picture film on each segment or frame of which is a picture, with labels, letterings, legends superimposed over and projected on wall or screen to amplify what is shown. This series has been planned so that the power plant may base a safety course or program on the well organized visual material, or integrate it with any program already in use. This material is basic and fits in a safety program in a wide variety of industries.



Each machine has a motor controller. This controller is a switch operated by electricity. When you press a button, electricity turns the switch on or off.

Three of the eight slide films available dealing with the basic safety procedure in handling switches and other power equipment. These films are of course not for use with experienced operators; they are intended for people who have very little training in the running of power equipment. Photos copyrighted by the Jim Handy Organization



There are different types of power controls. To work safely, you should know how to operate the controls in YOUR shop. However, knowing how to operate other types of controls will help you work safely in any shop.

Power must be used intelligently. Each person who uses a machine should have respect for power. He should use common sense to keep power under control.

Alternating Current Made Easy

By Eugene George Key

ALTERNATING current theory has mystified many practical electricians for more than half a century. Even electricians who are thoroughly familiar with direct current feel themselves floundering in pathetic confusion when they try to understand alternating currents.

Actually, there is no basic difference between direct currents and alternating currents. An alternating current is simply a pulsating direct current that changes direction of flow. Whenever a direct current changes in value, it presents exactly the same phenomena as an alternating current which changes in value at the same time rate. Contrary to popular belief, a condenser is not an open circuit to direct current which changes its value

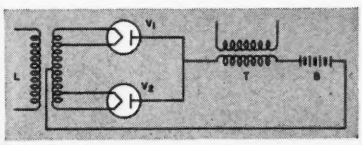


Fig. 1. Connections for full-wave rectifier

constantly—as a pulsating direct current—any more than it is an open circuit to an alternating current. Pulsating direct currents can be used to transform voltages just as alternating currents can be. Two commonly used electric machines which depend on the transformer possibilities of direct current voltages are the telephone and the ignition systems of automobiles.

Suppose a full-wave rectifier is connected as shown in Fig. 1 and a transformer inserted at T. B is the battery which makes the anode of tubes V_1 and V_2 positive. The wave form impressed on the primary of transformer T is shown in Fig. 2a. If an oscilliscope were connected to the secondary of the transformer, it would indicate that an alternating current voltage is induced which has a wave form similar to that shown in Fig. 2b, having a frequency double that of the impressed line voltage, L.

The principals illustrated in Figs. 1 and 2 are not as impractical as they appear on first consideration. A radio amplifier impresses a pulsating direct current on both audio and radio frequency transformers. The only difference is that the impressed wave shape is very different from that shown in Fig. 2a and the induced voltages are different from that shown in Fig. 2b.

Even steady-state direct currents, such as are obtained from batteries follow the laws of alternating currents for sometimes several seconds after the circuit is closed, especially if the load on the battery includes coils of wire (inductive reactance in alternating current) or condensers (capacitive reactance in alternating current) or both. Either the current or voltage will lag in such a circuit, depending on whether the circuit is inductive or capacitive. However, since any condensers in the circuit act as open circuits when steady-state conditions are attained, consideration of condensers can be omitted from the discussion. Different conditions are met in an inductive circuit, however.

Figure 3 shows what happens when a direct current voltage is impressed on an inductive circuit if the voltage is not pulsating. The voltage rises instantly to its maximum value, but the current may take several seconds to reach its maximum value at A. If the switch is opened the instant point A is reached, the voltage will drop immediately to zero, but the current will decay gradually as indicated by the dotted line, forming a wave shaped not unlike that of one alternation of a distorted alternating current wave. Here, then, we find exactly the same condition that exists in an alternating current circuit—the current lagging the voltage.

A mathematical equation has been derived to show the rise of the current from zero to point A in Fig. 3. The equation is as follows:

$$(1) \qquad I = \frac{E}{R}\left(1 - \frac{Rt}{\varepsilon L}\right)$$

where I is the current in amperes, E is the voltage in volts, R is the resistance in ohms, ε is the base of natural logarithms (equal to 2.7183), t is the time in seconds, and L is the inductance of the circuit in henries. The only difficulty with the equation is that it does not show exactly the conditions beyond point A, for as the time, t, increases, the current I continues to increase beyond the actual maximum value, since t is the only value on the right hand side of the equation to change. Compensating for this apparent discrepancy, however, is the fact that the actual increase in the value of the equation is extremely small and can be ignored.

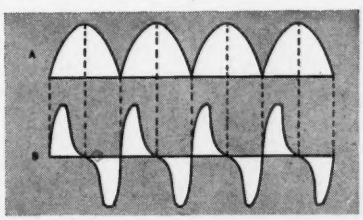


Fig. 2. Wave forms of Fig. 1. A—Wave form impressed on primary of transformer T. B—Wave form of induced voltage on secondary of transformer T

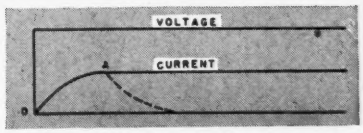
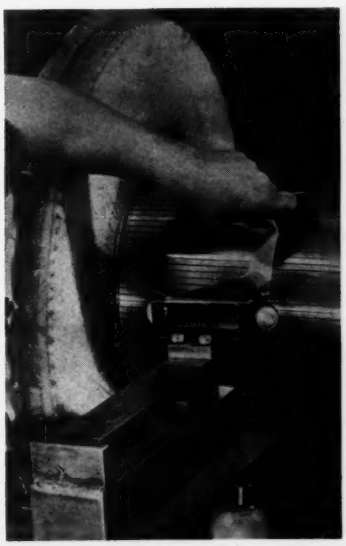


Fig. 3. What happens when non-pulsating dc voltage is impressed on an inductive circuit

This is the first of a series of three articles on alternating current theory. In the next article, the mathematics of the series circuit will be discussed, showing how easily the direct current laws can be converted to apply to alternating currents.

Indicator Speeds Checking of Motor Commutators

AN EXTREMELY rapid and accurate method of checking the roundness of motor commutators is employed at the Schenectady plant of the General Electric Co. This method involves the use of a G-E vibration displacement indicator whose design has been slightly altered to meet the requirements of this application.



This instrument, which indicates variations in roundness up to 0.00025 of an inch on commutators in motors running at high speed, is a small, flat, triangular-shaped instrument with a projecting stylus. For this application the conventional stylus, which has a pointed end, is replaced by one with a rounded end, and a weaker spring is substituted for the one which ordinarily actuates the stylus. This is done to prevent the stylus from scratching the surface of the commu-

tator. Also, the indicator is mounted on a short metal bar which serves to hold it firmly against the commutator.

In operation, as the stylus is moved toward the commutator, a piece of thin paper is inserted between the two to further protect the commutator. As the stylus follows the vibration of the rapidly rotating commutator, it moves longitudinally in and out of the instrument. This movement is transmitted to a small pivoted mirror which reflects a spot of light back and forth on the instrument's rectangular scale. The length of this oscillatory light path on the scale, which is calibrated in easily read divisions of one-thousandth of an inch, accurately indicates any variation in the roundness of the commutator.

The standard vibration displacement indicator is handled by General Electric's Special Products Division and is furnished with either a 15-mil or a 30-mil scale range. Its frequency ranges from 15 to 250 cycles per second when hand-operated, and from 0 to 250 cycles when mounted rigidly, as in this application. Flashlight batteries provide power for the light source in the indicator.

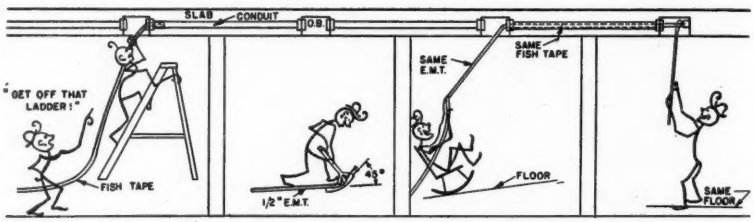
PRACTICAL HINTS AND KINKS

Handle the Fish Tape from the Floor

I WOULD LIKE to present the following "kink" which I feel sure will result in a double saving—time and effort—for the many who, like myself, must keep their fingers bruised and lacerated from working in and around outlet boxes.

Take a proper length of EMT (thin wall conduit) because it is lighter than piping or thick walled conduit, and bend a 45 deg angle on one end. Insert this angled end in the outlet box. Then, the electrician may stand on the floor and feed the fish tape directly into the lower end of the EMT and push the tape to the end of the run.

It is then pulled out of the run and down to the floor where the wires to be pulled can be hooked on. Then, all that is necessary is to pull it back the same way, pull it down to the floor, cut off the tape



The Turbo-Encabulator in Industry

It is pointed out by Arthur D. Little, Inc., that for 20 years it has attempted to interpret scientific information in terms easily understood by the layman. The editors of this magazine can sympathize with this aim and wish to add their voices to the forthcoming spasmic refurbulations which undoubtedly will be related by that which most apparently already is in a state of polar non-flux. **The Editors**

FOR a number of years now work has been proceeding in order to bring perfection to the crudely conceived idea of a machine that would not only supply inverse reactive current for use in unilaterial phase detractors, but would also be capable of automatically synchronizing cardinal grammeters. Such a machine is the "Turbo-Encabulator." Basically, the only new principle involved is that instead of power being generated by the relative motion of conductors and fluxes, it is produced by the modial interaction of magneto-reluctance and capacitive directance.

The original machine had a base-plate of prefabulated amulite, surmounted by a malleable logarithmic casing in such a way that the two spurving bearings were in a direct line with the pentametric fan. The latter consisted simply of six hydrocoptic marzelvanes, so fitted to the ambifacient lunar waneshaft that side fumbling was effectively prevented. The main winding was of the normal lotus-o-delta type placed in panendermic semiboloid slots in the stator, every seventh conductor being connected by a non-reversible tremie pipe to the differential girdlespring on the "up" end of the grammeters.

Forty-one manestically spaced grouting brushes were arranged to feed into the rotor slip-stream a mixture of high S-value phenylhydrobenzamine and five per cent reminative tetryliodohexamine. Both of these liquids have specific pericosities given by $P = 2.5C.\ {}_{n}{}^{6.7}$ where n is the diathetical evolute of retrograde temperature phase disposition and C is Cholmondeley's annular grillage coefficient. Initially, n was measured with the aid of a metapolar refractive pilfrometer (for a description of this ingenious instrument, see L. E. Rumpelverstein in "Zeitschrift für Elektrotechnistatischs-Donnerblitze" vol. vii), but up to the present date nothing has been found to equal the transcendental hopper dadoscope. (See "Proceedings of the Peruvian Academy of Skatological Sciences" June, 1914.)

Electrical engineers will appreciate the difficulty of nubing together a regurgitative purwell and a supramitive wennelsprocket. Indeed, this proved to be a stumbling block to further development until, in 1942, it was found that the use of anhydrous nangling pins enabled a kryptonastic bolling shim to the tankered.

The early attempts to construct a sufficiently robust spiral decommutator failed largely because of a lack of appreciation of the large quasi-piestic stresses in the gremlin studs; the latter were specially designed to hold the roffit bars to the spamshaft. When, however, it was discovered that wending could be prevented by a simple addition to the living sockets, almost perfect running was secured.

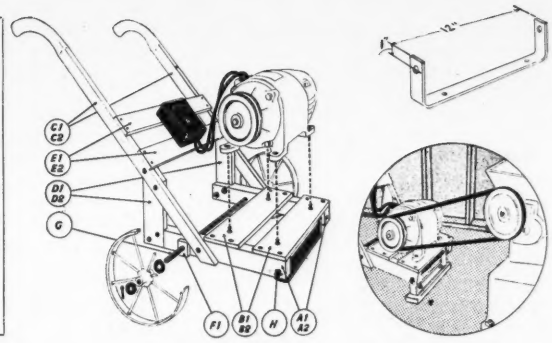
The operating point is maintained as near as possible to the h.f. rem peak by constantly fromaging the bitumogenous spandrels. This is a distinct advance on the standard nivelsheave in that no dramcock oil is required after the phase detractors have remissed.

Undoubtedly, the turbo-encabulator has now reached a very high level of technical development. It has been successfully used for operating nofer trunnions. In addition, whenever a barescent skor motion is required, it may be employed in conjunction with a drawn reciprocating dingle arm to reduce sinusoidal depleneration.

Comes word from Arthur D. Little, Inc., that it has at last succeeded in discovering the origin of "The Turbo-Encabulator." The author is J. H. Quick, a graduate member of the Institution of Electrical Engineers, London, England. The treatise was first published in the Institution's "Students' Quarterly Journal," in December, 1944. It jumped across the Atlantic without indication of author or origin.

MATERIALS

Key No.	No. of Pieces	Items	Dimensions	Use
A1-A2	2	Lumber	2"x4"x26"	Side rails
B1-B2	2	Lumber	1"x6"x16"	Base for motor
C1-C2	2	Pine handles	60" long	Handles
D1-D2	2	Lumber	1"x4"x18"	Brace for handles
E1-E2	2	Lumber	1"x4"x18"	Handle Ties
F1-F2	2	Lumber	1"x2"x3"	Space between wheels and side rails
G	1	Pipe	1" x25"	Axle
H	1	Pipe	1" x18"	Yoke Axle
	4	Collar pins	5/16"x1½"	Axle ends and hinge pin
	4	Flat washers	1"	Axle
	12	Carriage bolts	1"x6"	Fasten 1"x6" to side rails
	14	Carriage bolts	1"x2"	Fasten handle to brace
	6	Carriage bolts	1"x3"	Fasten handle to side rails
	4	Carriage bolts	1"x2"	Fasten Motor
	32	Flat washers	1"	Fasten Motor
	2	Wood or steel wheels	2 rubber tires, 12" diam size or larger	
	1	Bar iron	2"x¼"x20"	Yoke



For directions on how ot build this motor toter read the article

and let the wire slide back to the desired position, preferably, with 8 or 10 in. extending from the box.

A man on the other end holds the wires while the one with the fish tape jerks it free. With practice this scheme can be extended to take out many of the "ups-and-downs" in the wireman's life.

Houston, Tex. M. M. AVANT

How to Build a "Motor-Toter"

IF YOU have ever wanted to have one motor that could be a Jack-of-all-trades for you — one that could be wheeled about the plant to the site of any "once-in-a-while" job which required power, it is quite possible that a "motor-toter" such as this one could solve some of the difficulties. Just build yourself one of them, if such is the case. The accompanying drawing and bill of materials will enable you to build such a motor cart. This cart is so designed that it can be made from wood, and pieces of steel and iron from unused machines.

Yoke: The yoke, attached to the front of the cart, provides a quick and easy way to fasten the cart frame rigidly in position to permit proper belt alignment. It also incorporates the principle of using the motor's weight to maintain belt tension. The yoke pivots about the ½ in. pipe, permitting the motor and cart to be raised or lowered as desired for adjusting belt tension.

Holes in the yoke fit over properly-spaced bolts permanently imbedded in the floor next to the machine to be driven. The bolts may be either sunk in a concrete floor, or thrust upward through a two-by-four nailed to a wooden floor. Put the yoke in place over the tie bolts and use wing or thumb nuts to fasten it quickly and easily.

For Frame Mounting: In some cases it may be desirable to mount the motor directly on the frame of the driven machine.

When this is to be done, drill holes corresponding to the yoke bolt holes in the frame at the proper height. Bolts may then be inserted clamping both yoke and frame together.

How To Mount Motor: To put the motor in position to drive the machine, push down on the handles of the cart until the yoke is at proper height to slip easily onto the bolts. Fasten the yoke, raise the handle until the belt or belts can be slipped over the motor pulleys. This permits the motor and cart to pivot around the yoke shaft, using the weight of the motor to maintain belt tension. By trial and error in mounting the yoke to the frame, you will find the proper tension. Too great tension will wear out both machine and motor bearings and the belt. On the other hand, the belt must be tight enough to prevent slipping. —R.E.A. News

Metal Bending and Straightening

ON PAGE 108 our regular monthly chart is presented. This month the chart shows the basic operations necessary for bending and straightening metal prior to its installation of fabrication. Typical of the operations are these: Housing Structural Shapes, Upsetting Wire or Rod, Forming Circular Irons or Shapes, etc. These twelve sketches of common jobs show where and how to use the oxy-acetylene heating flame to get the best results. By applying the principles involved in these simple jobs, the operator can handle the more complicated work as it comes along.

LETTERS AND COMMENTS

Coal Pile Temperatures

IN THE JUNE issue of POWER PLANT ENGINEERING, J. R. Darnell comments on my instrument for taking coal pile temperatures, Mr. Darnell says it is not practical. First, I would like to say that any contributions submitted by me to this magazine are submitted for what they are worth to the reader. It should be obvious to Mr. Darnell, or any one else well versed in engineering that an instrument produced of several pieces of scrap iron pipe, a few welds and a thermometer and costing around $2.00 is not going to be as accurate and practical as one manufactured by a firm producing these type instruments and selling for from $100 to $150. It should be further obvious that, while many firms supply their engineers with expensive instruments with which to carry on their work, there are many who do not supply them. In these cases, many home made gadgets have been welcomed.

In taking coal pile temperatures one is more concerned with the RISE in temperatures above normal than he is with the accurate temperature of the coal itself, such as he would be with oil, water, steam or some like item. If we stick a spot in the coal pile to-day and the temperature reads 100 F and we stick the same spot to-morrow and the temperature is 150 F, we know that a hot spot is evident and we either do something about it or keep a close check on it.

The instrument, mentioned in my article, *was made and was used* at a chemical plant during the war when priorities on such items prevented their being obtained. It was used in taking temperatures and locating hot spots in a coal pile of from 1000 to 2000 tons.

The instrument is not 100 per cent accurate and I never said it was. I left it to the good judgment of the readers to realize that by virtue of its construction and use it could not compete with pyrometers costing 100 or 150 dollars. I submitted it for what it was worth to the individual reader. Obviously, if a man has an expensive instrument, made by a reputable firm for doing this type of work, then he would consider this item as just so much junk. On the other hand, if he happens to be employed where such expensive items are not supplied, he may find it a very valuable substitute.

Baltimore, Md. CHAS. W. PARKS

Bottles on Purge Line are Dangerous

FOR MANY years I have been associated with industrial refrigeration and have always read with great interest all articles on this subject.

All articles on removing non-condensible gases invariably show the use of a small neck bottle for the purge line. The excellent article by Mr. Holman in the May issue is typical.

It is my recommendation that this idea should be discouraged. The vessel should be an open top bucket or

barrel and be at a distance from the valve.

About two years ago an experienced engineer was operating a non-condensible gas separator equipped with a small necked bottle. He was putting the purger into operation and was opening the valve to relieve the non-condensible gases into the bottle. This sudden release of pressure into the jar caused the highly saturated ammonia water to burst into the air. As a result the engineer was severely burned in the face and eyes. He suffered great pain and lost his right eye.

No doubt there can be plenty of discussion on the operation of the purger and the condition causing this unusual accident; however, with the thought it could happen anywhere I offer these thoughts to practical engineers.

BERNARD L. LINDBERG

Sioux City, Iowa.

Opportunity, Knocks?

There is no desire on the part of this magazine to start a fraternal war between engineers. The following sequence of advertisement, letter and answer is presented on these pages in the interest of stimulating thought and expression from the readers of POWER PLANT ENGINEERING regarding the professional status of engineers. We shall be glad to review any comments our readers care to make on this subject.—The Editors.

Dear H. E. D.:

A friend of mine, an experienced power plant engineer is making a change. In trying to help I chanced to note your unusual advertisement in the Chicago Tribune.

MECHANICAL ENGINEER

Wanted—A first class WORKING industrial mechanical engineer between 30 and 40 years of age. MUST be a draftsman, know how to do lathe work, electric welding and drill press. With knowledge of quick freezing and dehydrating machinery. Preferably a man who has worked in canning plants or canning company and is thoroughly familiar with general plant maintenance, also construction and installation of runways and conveyors. Year around work. Salary $250.00 for 1st month, then advance to $300.00 as soon as proven ability to handle the job. During production period 60 to 75 hours weekly, nonproduction period, 50 hours. Do not answer if you cannot qualify fully. Splendid future for the right man.

MECHANIC

for factory maintenance work. Machinist

I belong to that class of professional consulting engineers who are sometimes facetiously referred to as "insulting" engineers. Probably after you read this letter you will agree.

Your advertisement is a unique, if not naive, document and I can hardly believe that any business concern would have the temerity to enumerate the multiplicity of duties which it expects an engineer to fulfill at the wages (not salary) which you say you will pay.

You say you want "a first class working industrial mechanical engineer between 30 and 40 years of age, who must be a draftsman, know how to do lathe work, electric welding and operate a drill press. He must also have a knowledge of quick freezing and dehydrating machinery, preferably a man who has worked in canning plants or canning companies and is thoroughly familiar with general plant maintenance; also construction and installation of runways and conveyors. Year round work."

Surely in his spare time such an engineer ought to find time to sweep the office and act as garage mechanic for the cars of the company officers.

For such idle spare time work plus his regular duties you say that the salary will be "$250.00 for the first month, then advance to $300.00 as soon as proven ability to handle the job. During the production period, 60 to 75 hours weekly, non-production period, 50 hours. Splendid future for the right man."

This might indicate that the engineer would be allowed off on Sundays but I know from personal experience that the poor engineer almost always has to do repair work on Sundays on machinery that the production manager, hounded by the front office, will not permit out of service during the six days of the week that the machinery is pounding out dollars for the company and pennies for the engineer.

During the first month (perhaps longer) that the engineer is working for $250, if it happens to be during the production period of 60 to 75 weekly hours, (probably 80 plus), he will be paid at the munificent rate of about 74 cents per hour (337.5 hr) if the month has 31 days and only 4 Sundays.

When he is loafing during 50 hours per week and enjoying the unheard of luxury of $300 per month, he will be making so much money for such little work that the company may be tempted to cut his pay. He will be getting almost 89 cents per hour.

You should not expect any self-respecting mechanic, even if he can only run a lathe to work for the chicken feed you propose to pay. A young engineer just out of college might work for such wages for a short time but he wouldn't have the experience you demand. About the only man who might accept such a job would be one who has escaped from prison and hopes to hide out in your village.

Your advertisement, however, does give me an idea. For some time I have been considering moving and for that reason would be willing to sign a contract with you for a term of 10 years to fulfill all the duties you enumerate at an annual salary of $6,000 based on a normal week of 40 hours with time and one-half for normal weekly overtime and double time for Sundays and holidays. In addition you are to hire an assistant at not less than $200 per month.

If you want competent service in these times you must pay for it. The ancient struggle between Capital and Labor has been going on for centuries with the pendulum swinging to the right and then to the left. At present I think that most of the unions are abusing their privileges and jeopardizing their hard won rights but it is such companies as yours that have caused the common laborer to be persuaded by union leaders to go out on strike. And I can't say that I blame them. I have never been in sympathy with the tactics of some union leaders but such tactics as shown by your advertisement shows why unions are organized.

Just to forestall your query as to what disgruntled crack pot I may be, I wish to advise that I am a member of the American Society of Mechanical Engineers, a director of the Illinois Engineering Council, listed in Who's Who in Engineering, Who's Who in Chicago and Vicinity and a contributor to various magazines dealing with power plant practice. It seems to me to be a dereliction of duty not to inform some of these magazines of your advertisement and to inquire if such practice is common.

If you have the intestinal fortitude to answer this, I shall be interested in your attempted justification for industrial slavery and will assure you that your answer also will be given publicity.

J. R. D.

H.E.D.'s Reply to J.R.D.'s Letter

It is with extreme pleasure that we acknowledge and reply to your letter of January 22.

First of all, our ad was not to entice men with exalted ideas of their great worth and ability. Had we stated in our ad the actual salary that the man with the required ability can earn in this organization, we would have been flooded with replies from every "crackpot." However, there were two young men with vision who picked up the phone and requested an interview. Both were the complete answer to our ad and one was employed, the other we expect to find an opening for in our expansion program. These men, in due time, will earn much more than the amount you offered your services for.

We have several men with ability who are earning from $4,000 to $12,000 yearly and with the lower living costs their net earnings are greater than what they would be in other localities.

Our part of the country has struggled against heavy odds for a long time due to discrimination in transportation rates, etc., but during the past twenty-five years many fine people have visited us and have be-

come more sympathetic and many who have stayed are good citizens and have shown a willingness to help build our state to the place it deserves. Men like yourself, have no place in the development of this great land and it is well you stay where you are. But don't do any injustice to the young men by instilling such exalted ideas in their minds. Your forefathers were pioneers and helped build this country with the sweat of their brows. There is still plenty of pioneering to be done and the men who can see farther than the end of their nose will have a profitable future. But those with your ideas will die of old age and never see more of the sun than their blind eyes will permit. H. E. D.

Low High Pressure

I WILL venture into the realm of the fantastic. A boiler inspector claims that a low pressure boiler with a safety valve set at 10 psi atmospheric and operating with a vacuum return of 15 in. is in reality a high pressure boiler. (The dividing line between low and high is 15 psi atmospheric.)

He figures it this way: Disregarding all valves, the boiler is under pressure of 24.7 psia. He subtracts 7.5 psi which is the equivalent of the 15 in. vacuum. Adding the 7.5 psi to the 10 psi atmospheric gives a total of 17.5 psi atmospheric and if the safety valve (which was disregarded) should fail to operate, we have a high pressure boiler. PHEW!

New York EDWARD W. GRAY

The Alberta Boilers Act

SINCE MY OPEN LETTER on the Alberta Boilers Act so kindly published in POWER PLANT ENGINEERING, I have occasionally been looking over such parts of the Act as I have in my possession. One may be readily excused if he fails to get a clear picture of what is the real intention of the Act, but however this may be, I was struck with one paragraph, which reads as follows: "No person shall install any steam plant, or pressure vessel, unless the same has been constructed in accordance with the regulations governing design and mode of construction." Now, everyone will agree that this statement covers some territory, or does it?

Just what is meant by this statement, can hardly be discovered if one was to visit some of the plants I have been in, and also some I have operated for a time. In most of the plants, the design and layout was something wonderful to behold, and seemed like Topsy in Uncle Tom's Cabin just to have growed. From this first hand evidence, one is forced to the conclusion, that this instructive paragraph is only applied to particular pieces of apparatus used in their design and construction, as apart from the general assembly of the plant, for convenience and proper operation, and what might be termed recognized standards of engineering.

On the other hand, the engineer to obtain a license to operate, is called upon by examination, to show that he has a good knowledge of how a power plant should be constructed, in fact he must be able to design a satisfactory layout according to recognized standards, if the regulations governing examinations are followed out. Yet when he takes charge of a plant, he very seldom finds conditions similar, or that the knowledge he was required to have, has been applied to the construction of the plant. He also finds very readily in most cases, that the owner or manager has no intention of allowing him to apply this knowledge, be it arranging as best he may, the muddle of inharmonious junk he has taken charge of; or be it the building of a new plant or any addition thereto. The fact that the inspection department has allowed the plant to be constructed in the way it is is sufficient for the owner and he can see no valid reason why the engineer should take objection to it. Furthermore, as the inspection department has granted the engineer a certificate by examination, argues, that the inspectors know more about it than the engineer.

I have seen firemen and engineers as well, working under the most unreasonable conditions and hardship, for the lack of application of some engineering sense, but I have never heard of the inspectors acting to alleviate such conditions, nor come to the support of the engineer if he tried to get something done about it. This brings forward the question, shall the Government stop at the matter of safety from accident or insist on engineering precautions, so that reasonable working conditions may be established for the health and well being of those so employed? It would appear from the Act and its intention, that any plant that came under its provisions would be designed and built to insure reasonable operating and maintenance conditions for the engineer and his staff.

As to the regulations governing design and mode of construction, these mostly exist in the minds of the inspectors, and from the appearance of plants, they are not given a free hand in the matter, or they simply don't know how.

I have laid some stress on what the engineer is required to know to obtain a license to operate. From the variety of engineers I have met in my experience, there appears to be a wide discrepancy in just how they obtained a certificate. As the examination is wholly a written one, quite a few seemed to have obtained a pass on a memory test, and when confronted with a practical demonstration of the knowledge and skill they are supposed to have, have failed miserably to justify the ticket they held. Here again, one might question seriously where they obtained their experience, and there appears to be little doubt, that they obtained testimonials, that would not have stood strict investigation.

In recent years there have been a great many of these opportunists who have been able to trade on the competent engineer and obtain the same wages. A competent examiner should be able to put this kind in the category they belong to but the examiners themselves in some cases would be unable to distinguish. It seems as long as the inspection department has in its possession sufficient written evidence of apparent competency that is sufficient. The net result of such laxness has been to keep wages and salaries down; reduce the attractiveness of the engineer's occupation in favor of a plumber's or steamfitter's, etc., as the wages average much higher in most cases. The department continues the downward trend of events by issuing temporary certificates to fill positions, by those who are not qualified, complaining about the scarcity of engineers as such, although the evidence all points to their own inadequacy.

The degeneration has proceeded to such an extent, that as has happened, engineers with the necessary qualifications have found themselves without a job, while positions were being filled with temporary appointed engineers, who appeared to be more or less permanent. To make the degeneration more complete, it is no longer necessary to have a full time Chief Boiler Inspector, although one would imagine the interpretation of the jumbled mess called the Boilers Act, would require very diligent application.

The Act and its administration today, is an amazing piece of impudence. Even the part time Chief Boiler Inspector who is supposed to administer the Act, has not the necessary qualifications for his appointment, as the Act distinctly states that he must have been a Boiler Inspector under the Act before his appointment, which he certainly never was.

The question of course arises, as to the best means to use, to overcome this very undesirable state of affairs, and restore the Boilers Act, with due revision, so that it cannot be so easily tampered with again. To a large extent the engineers are to blame for present conditions. Attempts have been made from time to time to organize the licensed engineers, but these attempts have failed, because they were mainly concerned with matters that could be left to other unions owing to the scattered nature of the engineer's employment. It is about time, if not too late, that the engineers faced up to realities, and formed an association for a very obvious purpose, which has been made plain enough, without saying anymore.

WM. S. WHITE

Hammond, B. C.

Questions And Answers

Question No. 341

Performance Chart for Extraction Turbine with 1 Uncontrolled Bleed Point

I HAVE BEEN trying to obtain information on the procedure of deriving a performance chart of a single-extraction steam turbine with one uncontrolled bleed point. Thus far I have been unable to do so.

I have seen performance charts of this kind with the lines representing the various amounts of uncontrolled extraction drawn parallel to a zero extraction reference line. As I see it this is incorrect because, if the lines are drawn parallel, it means that the extraction factor (pounds added at the throttle per pound extracted at the uncontrolled bleed point) is constant at all steam flows after the uncontrolled nozzle. That is another way of saying that the pressure at the uncontrolled extraction point remains constant at all steam flows. This would not represent the actual conditions.

In a double-automatic extraction machine, the lines are drawn parallel because the extraction factor remains constant, since the extraction pressure is maintained constant by the pressure-regulating valve gear.

Milwaukee, Wis. N. S. M.

Editor's Note—There is brief discussion of uncontrolled extraction on pages 10, 11, 83 and 84 of Modern Turbine by L. E. Newman originally published in POWER PLANT ENGINEERING. But that discussion does not show a performance chart for such conditions. See also Steam Power Plant Engineering by Harding, Chapters IX and XI.

Question No. 342

How Calculate Combustion Space?

IS THERE a specific formula for figuring the combustion space to be allowed above the grates in a boiler of the straight tube type, such as, for instance a Heine straight tube boiler? Or does the type of boiler have any bearing on the space required?

Greencastle, Ind. C. F. M.

There is a specific *method,* rather than a formula, for calculating combustion volume of a furnace. But this method is based primarily on the kind of fuel, method of firing, type of furnace and necessity for proper furnace operation, more than upon the particular type of boiler involved.

Proper furnace operation means: no impingement of flame on furnace walls or boiler tubes, proper ignition (with certain types of stokers) minimum of slagging, proper mixing of combustion gases in the furnace, introduction of excess air, amount of heat release desired in the furnace, and so on.

True, the type of boiler does have some influence. In the case of a straight-tube boiler, if it is cross-baffled, the furnace must be of such a shape and volume that combustion will be essentially completed under the first pass of the boiler. However, if this same straight tube boiler is horizontally baffled, you can see that while the combustion volume would be the same, the furnace itself could be longer and not quite so high.

In a similar way, other types of boilers do have an influence on the shape of the combustion chamber but less influence on its volume than the the other factors named.

Perhaps the best survey of the general method of calculating combustion space is given by Gaffert in his book *Steam Power Stations* (McGraw Hill Book Co.) from which the following is reproduced.

The first step in the design of a furnace for a boiler is to analyze the operating conditions which may briefly be listed as follows:

1. Range of fuels to be burned.
2. Maximum steam output, and probable range of boiler load.
3. Operating pressure and desired total temperature.
4. Degree of heat recovery desired.
5. Type of firing.

Coal, oil, and natural or mixed gas require different amounts of excess air for satisfactory operation. Common allowances for boiler design for these various fuels are:

Coal:
- Stoker-fired furnaces ..... 30 per cent
- Pulverized-fuel furnaces ..... 20 to 25 per cent

Oil ..... 15 per cent

Gaseous fuels ..... 10 to 15 per cent

The next step would be to compute the fuel requirements for the maximum continuous steam output and for overload ratings. This computation requires an estimate of the efficiency of the boiler unit, and the latter, in turn, depends on the amount of heat recovery. In general, Table I may be used as a guide in estimating the probable efficiency of the complete boiler unit.

Accordingly the amount of fuel to be burned and the weight of combustion air and resulting flue gas can be computed and the amount of heat that must be liberated in the furnace established. It now becomes necessary

Table I. Data to guide in estimating probable efficiency of various complete boiler units

Fuel	Type of steam-generating equipment	Service	Average full-load efficiency per cent
Coal	Horizontal—and vertical—return tubular	Heat	65 to 75
Coal	Low head—water tube	Heat	70 to 75
Oil or gas	Low head—water tube	Heat	75
Coal	Water tube. No heat recovery	Power	75 to 77
Oil or gas	Boiler only	Power	75 to 80
Stoker coal (low grade)	Boiler and heat recovery	Power	80 to 83
Stoker coal (high grade)	Boiler and heat recovery	Power	83 to 86
Pulverized fuel—coal (low grade)	Boiler and heat recovery	Power	85
Pulverized fuel—coal (high grade)	Boiler and heat recovery	Power	85 to 90
Natural gas and oil (high grade)	Boiler and heat recovery	Power	84 to 88

Table II. Heat release rates customary in design work

Fuel	Method of Firing	Heat Release, Btu/(cu ft)/(hr)
Coal	Stationary grate	40,000 to 50,000
Coal	Stoker	30,000 to 35,000
Coal	Pulverized coal (dry bottom)	20,000 to 25,000
Coal	Pulverized coal (wet bottom)	35,000 to 45,000
Gas and oil	Air-cooled walls	15,000 to 25,000

to consider the desired flue-gas temperature leaving the furnace, for in the case of coal firing this should be below the fusing temperature of the ash in the coal. Small heating furnaces are usually lined with firebrick, whereas power boilers are economically equipped with air-cooled tile walls or waterwalls, the trend toward water cooling being very definite.

Only the volume of the furnace being considered in the case of stoker firing, the plan dimension is established by the allowable burning rate, and the height only is flexible. The heat-release rates shown in Table II are customary practice in design work.

Accordingly, the volume of the furnace can be set from the maximum heat evolution and the allowable heat-release rates. The physical arrangement of the furnace next requires consideration.

The shape and dimensions of the furnace for a given volume, would then depend on whether the fuel is fired on a grate or stoker or burned in suspension. If it is stoker-fired, the width and depth of the stoker to give correct burning rate per square foot, as well as correct total heat release, would fix the plan dimensions of the furnace and thus practically determine the height. For pulverized coal, oil or gas firing, however, the dimensions for a required furnace volume would be influenced somewhat by the arrangement of boiler and heat recovery equipment but on the whole can be shaped more or less at will to fit building conditions.

Question No. 343

He Wants Definitions of Utility Terms

WITH SO MANY large power companies tied together these days, a fellow needs a dictionary written especially for the trade to understand some of this new power engineering language he hears. Terms like "firm capacity," "relay capacity," "reserved short-term capacity," "unreserved short-term capacity" are a few of the words that are typical. Can you tell me the differences between these terms?

Evansville, Ind. R. F. L.

Answer No. 327

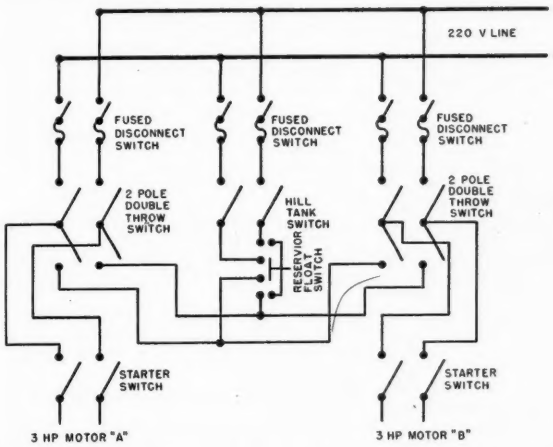
Another Water System Problem—Redesign the Control

Solution by Muellerhile

IN ANSWER to Question No. 327, I am submitting a wiring diagram which should give J. L. the flexibility he desires in the water system.

If the hill tank is a long distance from the pumps, there may be a large voltage drop in the line which might account for the contact point trouble on the hill tank float switch. To overcome this, I suggest he mount the hill tank switch near the motors and use a Mercoid float switch to operate it by remote control.

Winona, Minn. T. A. MUELLERHILE



How Muellerhile would rewire J. L.'s water system control circuit

Re-design by Eversz

PUT FLOAT switches in control circuits as shown, thus reducing electric load on them.

Remove interlock connection on each starter or use "two wire connections" if so marked on starter.

Be sure to "phase out" lines unless dotted wiring is used. If used, remove regular jumper at "x."

Manual switch can be used or not, although I would depend on the float switch.

Double-pole switch will change pumps at will; down puts A on Hill tank; up puts A on Reservoir.

Inglewood, Calif. H. M. EVERSZ

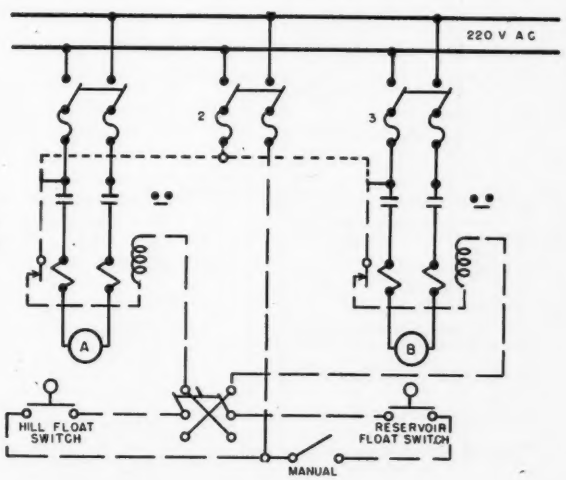


Diagram by H. M. Eversz showing how control system can be redesigned

Answer No. 323

Steam Engine Questions

Calculations for Engine Flywheel by Moulton

THE BEST way to explain the method of finding the weight and diameter of a flywheel is to take an actual example.

An 18 by 36 engine running at 80 rpm rates 150 hp with 40 lb mep, but will deliver 200 hp with 100 lb gage pressure. Now let's assume that this engine has no flywheel so we will design one for it.

First we want to know how big a wheel we want. Naturally we want it as big in diameter as we can have it because that means we can build it with the least weight. We know that the inertia effect of a flywheel varies directly as the weight and as the square of the velocity. That means if we double the weight we double the inertia effect while doubling the velocity increases it 4 times.

Also we must consider the type of wheel we need. In this case we must have a belt wheel with a face wide enough to carry a belt capable of transmitting the full power of the engine at 100 per cent overload without severe slipping. This type of wheel is usually a split wheel made in 2 sections, because it is much easier to cast a wheel this way and it is easier to handle when installing than a solid one. Besides, it is not subject to so severe shrinkage stresses and distortion that cause difficulties in construction.

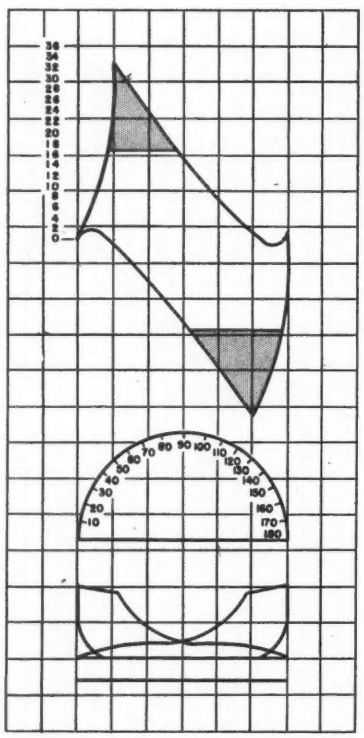
The mean safe rim speed for a wheel of this type is 3550 ft per min, which allows us a diameter of $3550 \div (3.1416 \times 80) = 14.13$, say 14 ft.

Next we want to know how wide the rim face will be. This will depend upon the width of the belt. Good practice allows about 9.7 hp per inch width for a 3-ply leather belt running 3550 ft per min. Then our belt will be 300 ÷ 9.7 = 30.93 in., say 31 in. In order to have a margin of face for the belt we will make the rim 32 in. wide.

We now have the diameter, the width of belt, the width of wheel face and the allowable rim speed (this can be exceeded by about 10 per cent without danger as there is usually a wide margin of safety in the design of the wheel). Perhaps the accompanying energy diagram will show graphically the function of the flywheel in relation to the work done in the cylinder.

This diagram, starting at the dead center position, shows what takes place in the engine cylinder at 10-degree intervals around the crank circle during 2 strokes or 1 revolution of the engine. Directly under the crank circle are 2 indicator cards—1 crank and, 1 head end. Directly above it is an energy graph plotted from the energy scale, through points projected from indicator cards up through points on crank circle.

The value of the curve at any point is equal to the area of the piston times the pressure at point taken times sine of crank angle. The solid black area shows the energy that has to be taken in and given out during the stroke.



Flywheel energy diagram by Albert H. Moulton

Before calculating the weight of a flywheel necessary to maintain a certain speed variation we must know just how much energy we have to deal with. The engine horse power is 200, 1 horse power = 33,000 ft lb of work per minute or 550 ft lb per sec. The total energy required is 550 × 200 or 110,000 ft lb per sec. As a minute is too large a unit of time in which to measure the stroke of an engine we will from now on, measure time in second and fractions of seconds. The average turning effect on the crank is 9000 lb.

As the energy required is 110,000 ft lb per sec, the amount of stored energy is 110,000—9000 or 101,000 ft lb per sec for ¼ sec it will be ¼ of 101,000 or 25,250; say 25,000 ft lb per sec. This is the excess energy to be used in calculating the weight. We have taken the normal speed as 80 rpm or 1.33 rps; at 81.6 rpm it is 1.36 rps.

In designing a flywheel, we must remember that engine speed is never exactly steady. When we say that an engine runs at a certain speed, we mean its speed at its normal rated load under conditions for which it was designed. And as we all know, a flywheel cannot absorb or give out energy except by an increase or decrease of speed. We also, know that the ordinary steam engine governor cannot change its position except by a change of speed and is always behind the change and never ahead of it. Therefore there must always be a variation of speed and it is this speed variation that we have to deal with in designing a flywheel.

Next we want to know the weight of the wheel. This depends on the excess energy, the fluctuation factor and the rim velocity in feet per sec. The fluctuation factor depends on the allowable speed variation. For an engine driving mill machinery, a good average is 0.02 or 2 per cent between no load and full load.

The fluctuation factor

$$\frac{N_1 - N}{N} = \frac{81.6 - 80}{80}$$

= 0.02 or 2 per cent

The weight is found by the formula

$$W = \frac{w \times g}{v^2 \times k} = \frac{25000 \times 32.2}{3481 \times 0.2}$$

= 11,500 where

W = Weight of rim in lb
w = excess energy stored and restored in rim
g = 32.2
v = mean rim velocity feet per sec
k = fluctuation factor

The kinetic energy of rim at 81.6 rpm or 1.36 rps is found by formula:

$$K.E. = \frac{1}{2} \frac{W V^2}{32.2} = \frac{11,500 \times 3600}{64.4}$$

= 642,800

At 80 rpm or 1.33 rps

$$K.E. = \frac{11,500 \times 3441}{64.4} = 614,400$$

Where K. E. = kinetic energy of wheel; W = weight of rim lbs; 2 g = 64.4.

The difference = 642,800 — 614,400 = 28,400 ft lb.

Now as a check on our calculations let's take an example. How much will our flywheel speed up if the 200-hp load is suddenly thrown off. Let's assume that this occurs right after cut-off, the energy admitted to cylinder as steam was 110,000 ft lb per sec. At 80 rpm, 1 revolution is completed in ¾ second, stroke takes ½ of ¾ or ⅜ second. Then as cut-off ⅓ stroke, the expansion will continue until release or a little before the end of the stroke, but for all practical purposes we can say ⅔ of stroke, the amount of energy to be absorbed by wheel is ⅔ of ⅜ or ¼ of 110,000 which is 27,500 ft lb.

The acceleration in feet per second per second is expressed by the formula:

$$A = \frac{F\ g}{W} = \frac{27,500 \times 32.2}{11,500} = 77$$

Where a = acceleration in ft per sec. per sec.
F = accelerating force in lb
g = 32.2
W = weight of fly wheel rim

As the increase in speed is 77 ft for each second the increase in feet per second will be 77 ÷ 4 or 19 + ft per sec. The increase in rps will be

$$\frac{1}{4} \times \frac{19}{44} = 0.108 \text{ rps.}$$

The speed will then be 1.33 + 0.108 = 1.438 rps or 1.438 × 60 = 86.28 rpm an increase of $\frac{86.28 - 80}{80} \times$ 100 or 7.8 per cent.

This gives a rim speed of 86.28 × 44 = 3796 ft per min well within the safe limits.

Pittsfield, Mass. ALBERT H. MOULTON

Answer No. 328

Why Greater Pressure with Live Steam Than with Exhaust Steam?

Comments from McKay

THERE IS A very important question here to be answered first. Is the heating system kept on in the building the same number of hours each day, whether using live or exhaust steam?

I have known of plants, having engines and using the exhaust steam, that kept the heating on 24 hr a day; but when purchasing live steam for heating, it would be kept on only the actual number of hours needed. In the latter case, it will take the steam through the reducing valve a long time to get the building heated sufficiently, so a back pressure will build up in the steam lines with the same pressure at the vacuum pump.

I understand from the question that the building will heat better and have a back pressure on the system with exhaust steam, but will not do either when using live steam.

In regards to the returns and amount of vacuum, I would not want

a higher vacuum in this case, but rather the least vacuum I could carry and not have any water pounding or noise in the return system. This return pressure will depend on the return piping layout. If all the returns will run to the vacuum pump, carry as low as zero pounds pressure.

Another thing, is, most reducing valve manufacturers do not recommend so large a pressure drop as you are operating on—that is, 120 psig to 3 psig—for the valves generally may make a lot of noise and the wire drawing on low steam consumption is great. The low-pressure steam will be superheated as it leaves the pressure-reducing valve and will not give up its heat as readily as exhaust steam until it has lost its superheat. This will depend on the insulation on the pipe; the better the insulation, the longer the superheat will stay in the steam. This superheat will also have a bad effect on the radiator traps.

Not knowing the amount of steam the engine is using, it would be a guess as to whether a 2-in. pressure reducing valve is large enough. I would guess it might do the heating if the heating system is kept on 24 hr a day. It is not too large in your climate.

Washington 18, D. C. C. McKAY

Answer No. 330

Will Water Treatment Pay on These Heat Exchangers?

Unless Water Is to Be Re-used, It Won't, Says Slavinsky

FROM MY OWN experience in water treatment, unless the water can be re-used over and over again, I would say that the treatment would be too costly. As long at the water-cooling system is such that the water can be cooled and recirculated again, the system warrants treatment, but as long as the cooling water will go to waste, then it would require a considerable amount of chemicals to maintain a uniform concentration. Of course, when the system is shut down and it is desired to leave the water in the system without draining to sewer, it would be best to treat the water.

Ridgefield, N. J. J. F. SLAVINSKY

Answer No. 332

Heating and Purifying Swimming Pool Water

Use a Heater and Overhaul Filter

THE MOST economical method of heating the water in the pool described by R. N. B. would be through steam coils. Assuming that no exhaust steam is available then it will be necessary to use live steam. The best way to use this live steam would be through a temperature control thermostatic valve. By this means he can set the valve controls for any desired temperature and, once the water reaches the temperature desired, the thermostatic valve will shut off the steam to the heating coils in the pool. The condensed steam in the coils can be returned to the feedwater heater, then back to the boiler itself. In that way he will have less makeup water to use.

As for the filtering of the water, I would suggest he consult one of the filter manufacturers. The filter he now uses is probably undersized. Most of the filters used by the neighborhood swimming pools in this vicinity are a type that filter the water continuously, calculated to filter the complete pool of water within 24 hrs. Not only does the water get a complete filtering every 24 hr, but the bacteria count in the water is controlled by the addition of chlorine. All the pools in this part of the state are equipped with a chlorinator to hold down the bacteria count. The bacteria cannot be filtered entirely by a filter. POWER PLANT ENGINEERING has reputable advertisers who will be only too glad to furnish R. N. B. with the literature on the heat control valves and filtering equipment that needed to solve his problem. (Lists of these have been sent.—Ed.)

Ridgefield, N. J. J. F. SLAVINSKY

Answer No. 334

First He Wants the Steam Dry, Then He Wants It Wet—from Same Boiler

How Maguire Handled This Problem

YOUR PROBLEM is a common one in dry cleaning plants. My first stationary plant after leaving the Marine service was a dry cleaning plant and one of the first things the boss told me was not to pay any attention to the men pressers, because they would drive me nuts complaining about the steam—it was either too dry or was too wet. But as time went on I found that they were right; the steam *was* either too dry or too wet some days, depending on the weather.

My first try at solving the problem was to raise the level of the water in the boiler to make the steam wet and lower it to make it dry. This was a help, but when we got steam electric irons it made them drop water at times and I had to stop raising of boiler level.

At this time a change in plant layout was made and I installed a separate return line for the pressing machines, with one large trap and a throttling valve by-pass. When the pressing machines gave off wet steam, due to the change in atmospheric conditions, I opened the by-pass valve far enough to give the desired results. When the steam was too dry, I closed the by-pass valve and let the trap handle the returns. If the steam was still too dry, I shut the trap off and opened the by-pass just enough to keep the steam the right wetness for good pressing.

As this method of getting dry and wet steam is sometimes wasteful, to overcome it a closed feedwater heater was bought and all the returns, after passing through the traps, were led through this heater, plus the by-pass. In our case the heater supplied the hot water for the plant and the makeup water for the boiler also.

Whitley, Ontario W. D. MAGUIRE

Smith Suggests Two Steam Drum Connections

ATTACHED hereto is a sketch illustrating two possible ways in which both dry and wet steam may be obtained from the same boiler.

Arrangement No. 2 as illustrated will probably be found to be the most effective.

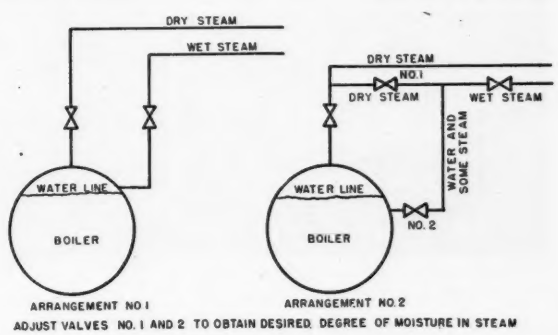
I know that the arrangements illustrated have been used successfully on smaller high pressure steam boilers and see no reason why they should not work on the largest type of boilers if properly applied.

J.E.Y. does not state in his question the horsepower of the boiler in use.

Obviously they should retain their present efficient trap system for returning condensate rather than to resort to the older, less-efficient method of condensate return that may have given them the wet steam they required.

In either case, the methods suggested in the attached sketch require the running of an additional steam line to the equipment requiring wet steam, but this should not be objectionable if the objective they seek is obtained.

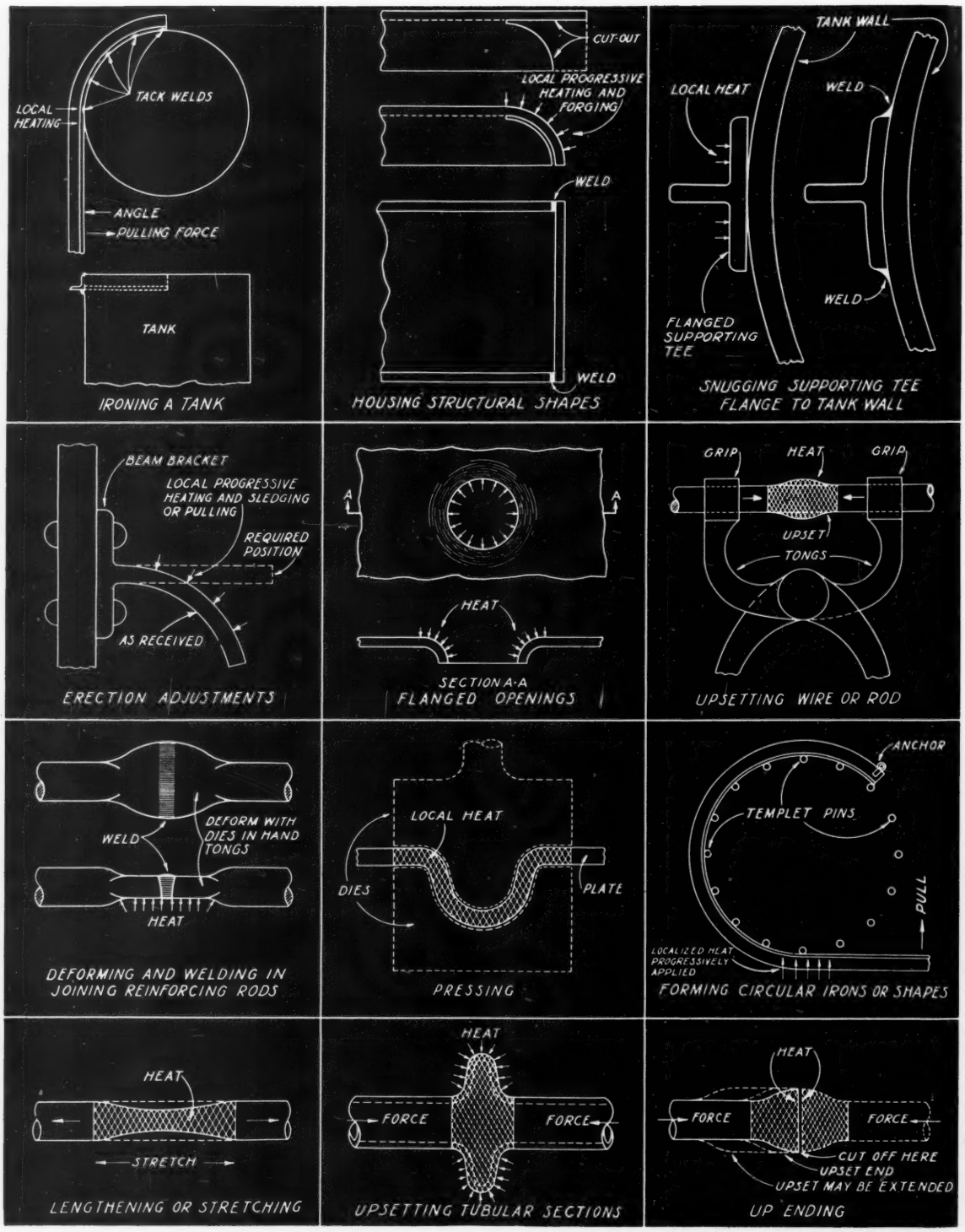
Los Angeles, Calif. CHESTER C. SMITH



How Chester C. Smith would supply both wet and dry steam from one boiler

CHART ON METAL BENDING AND STRAIGHTENING

(See Page 101)



From Oxy-Acetylene Tips

ATOMICS

Bikini Atomic Bomb Sinks 5 Ships, Wrecks 6, Damages 25

Without Hitting Any of Them

If you have any doubts about the effectiveness and success of Test Able, Operation Crossroads—the first atomic bomb test conducted by Joint Army-Navy Task Force One on an array of 72 Naval vessels at Bikini Lagoon, July 1, 1946—those doubts should be dispelled by this on-the-spot report from our own observer on the *U.S.S. Appalachian*. He describes the blast, gives details of the damage, discusses effects of pressure and temperature he observed after inspection of target ships. He explains what the scientists mean when they talk about a temperature of 100,000,000 degrees. Effects of radiations on various objects and on test animals. Details of some of the test instruments used. Entire operation carried out with great precision

By ANDREW W. KRAMER

Managing Editor, POWER PLANT ENGINEERING
Accredited Correspondent, Operation Crossroads

I—The Blast:

Aboard the U. S. S. Appalachian, Monday, July 1, 1946

TEST ABLE is over. The first atomic bomb exploded over the array of 73 naval craft anchored in Bikini Lagoon just 45 min ago.

It was a beautiful morning with only a few cumulus clouds in the sky. Fifteen minutes before "H" hour, planes could be seen in the sky in the direction of the target area and they reported good visibility over the target.

At H hour minus 30 seconds, the bomb was reported dropped and we received the order "goggles away." These last 30 seconds seemed very long. It was almost impossible to see anything through the almost black glass and we were in utter darkness.

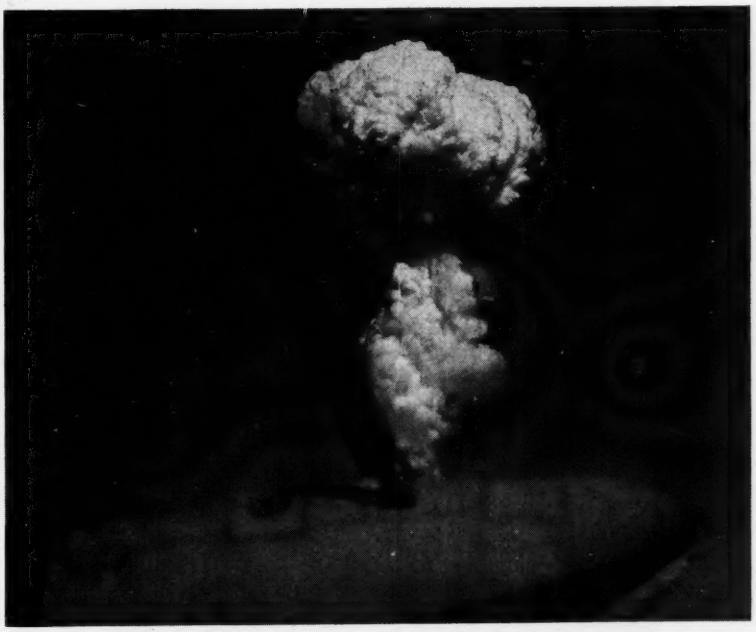


Fig. 1. A view of the atomic bomb cloud of smoke and flame, taken a few minutes after the blast from a navy patrol bomber flying just beyond range of the deadly explosion

The Blast

0900! There it was! A brilliant ball of light close to the horizon, which grew instantly into a semi-circle of slightly less intensity. At that instant we took the goggles off and there on the horizon we could see the great white hot mass of gas rising and from it there rose a great cloud of smoke. This rose rapidly and spread out. At 2½ min after the blast this cloud was 3800 ft wide.

At our distance of 18 miles from the blast we felt no heat effects from the blast and, when it came, about two minutes later, there was only a relatively weak audible blast. I felt only a slight pressure on the ear drums, nothing uncomfortable. One of the enlisted men who stood close to me reported a few minutes later, that he had looked directly at the blast with the naked eyes and that it had not affected his vision at all. It was bright, he said, but nothing uncomfortable.

The Cloud

In the meantime, the cloud rose rapidly. Seven minutes and 15 seconds after the blast it was 22,000 ft high and 8 min after, it was 30,100

All photos courtesy Joint Army-Navy Task Force One.

Fig. 2. One of the radar stations erected at Bikini Atoll as part of the elaborate control and instrumentation of the bomb test

ft high and 4400 ft wide. These estimates were made by one of our navigating officers using a sextent. Nine minutes after the blast the cloud was 38,000 ft. high and it was 12,000 ft wide.

During this time the color effects increased in intensity. For part of the time after the blast, the bulk of the great radioactive cloud was obscured by heavy cumulus clouds between us and the target but then it blossomed out beautifully above them, dazzlingly white tinged with deep red and pink in the lower and central portions. It looked like a giant ice cream cone in which a little strawberry was mixed with vanilla. It rose as one great mass and leaned a little in the direction of the wind. The red color persisted for well over a half hour and then again, the cloud was obscured by cumulus clouds between us and the cloud.

The outside effects being pretty well dissipated, I went down to the wardroom to watch the television screen. As I came in, a view of Bikini Lagoon was on the screen and we could see the ships lying at anchor. One was listing heavily and seemed to be sinking. The water of the lagoon still seemed to be stirred up and the water was filled with floating objects, obviously stuff that had been swept off the decks of the ships.

As I write, Admiral Blandy is making his first radio report and he says that the test was successful and that the bomb drop was very accurate. He also reports that the efficiency of the bomb was probably slightly less than that of the Nagasaki bomb. The observers on Admiral Blandy's flagship report that the heat effects of the blast were very noticeable but this was not our experience. We were somewhat more distant from the blast but we felt no heat effects whatever.

Together with the *Mt. McKinley* and the *Panamint* and the *Blue Ridge*, we are now just outside the lagoon and awaiting the signals from the radiological units before we will enter. Planes are flying directly over the target array, evidently taking samples and testing the degree of radioactivity.

A report from topside indicated that the *U. S. S. Independence*, the airplane carrier, is the most seriously damaged. Her superstructure seems to be virtually torn away and all of the planes on her decks have been swept off. There is also a big piece torn away from her stern. The ships sunk are the *APA-57*, the *U. S. S. Gilliam*, the *APA-69*, and the *U. S. S. Carlisle*. The destroyer *Lamson*, a 1726-ton, 341-ft-long ship was capsized.

There is a late report that both the Jap battleship *Nagato* and the German battleship *Prince Eugen* have been heavily damaged. This is surprising, if the report which emanated from the *Mt. McKinley* is true, because, the *Prince Euigen* was anchored on the outer edge of the array; the *Nagato* was anchored close to the *Nevada* but earlier this morning she appeared not greatly damaged.

Evidently, the degree of radioactivity in the lagoon is not too high, otherwise, we should not be as close in as we are just now. We are at the entrance of the lagoon and from the deck a few minutes ago I could see the drone boats going back and forth across the water.

At 1335 (1:35 p. m.) the latest estimate of damage is as follows: Destroyer *Lamson* capsized and the transports *Gilliam* and *Carlisle* sunk. Heavy damage to the *Skate, Independence*, the latter now adrift and headed for the *Nagato*. Light to negligible damage to the *Sakawa, Pensacola, Nagato, Nevada, Y0161* and *LCM-1*. Fires took place aboard the destroyer *Wilbur*, the *Sakawa*, the *Pensacola*, the transport *Brisco, Nevada, Saratoga* and the *Independence*.

Fig. 3. Another view of the atomic bomb cloud a few minutes after the blast

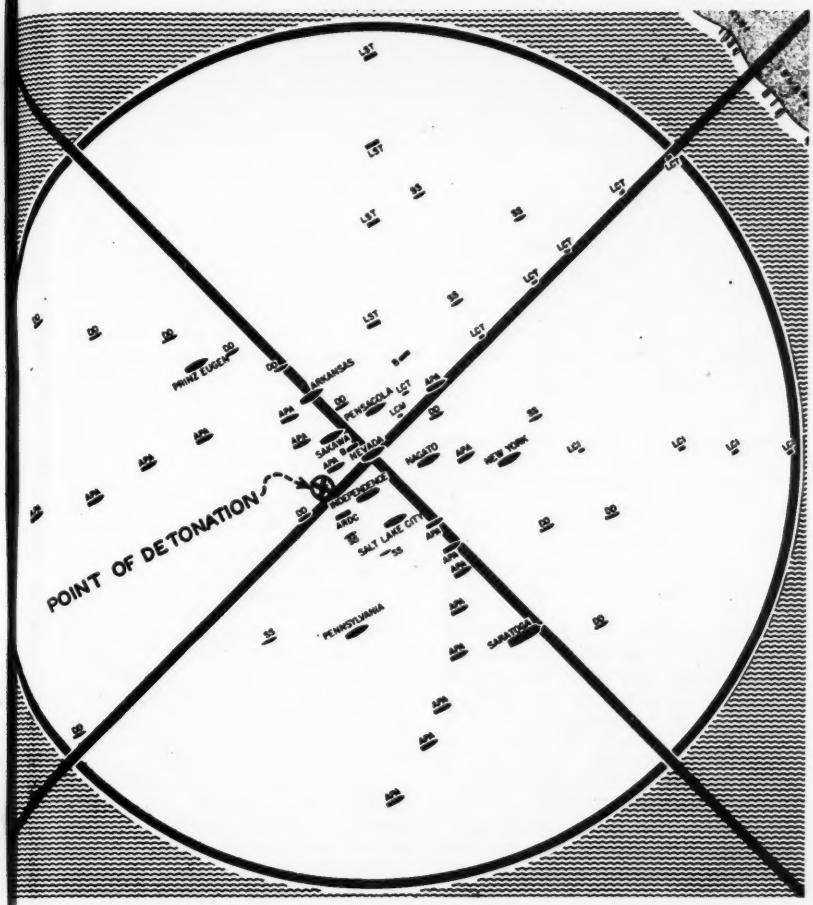


Fig. 4. Approximate disposition of ships in target array at Bikini, Test Able, July 1, 1946

DD—Destroyer LST—Landing Ship Tank LCT—Landing Craft Tank APA—Attack Transport
SS—Submarine LCI—Landing Craft Infantry LCM*—Landing Craft Mechanized ARDG—Floating Drydock
B—Barge

II—Effects of the Bikini Atomic Bomb

On board the U. S. S. Appalachian, July 4, 1946

THREE DAYS AFTER the atomic bomb dropped from a height of some 30,000 ft on the array of naval vessels anchored in Bikini lagoon, it becomes possible in a general way to evaluate the results of this first test. Curiously enough, the blast neither fulfilled the dire predictions of those who overemphasized the force of the bomb nor that of those who minimized its power. It took a middle course: it did not sink the entire fleet of ships but it did considerable damage, considerably more than was evident from preliminary surveys.

This, of course, was expected by those who know something about the strength of ships, particularly naval vessels. Ships are strong, much stronger than land structures, because, as has been indicated in these pages in earlier dispatches, ships are made to withstand the ceaseless force of the sea. Ships are made of steel—they are, in fact, girders and are tubular in form, one of the strongest shapes known, and as such can withstand forces far in excess of anything that land structures can be subjected to. It is not surprising, therefore, that out of the 73 vessels comprising the target array at Bikini, only five were sunk.

The Full Score

This fact, however, must not be construed to mean that the atomic bomb is relatively unimportant as a weapon against naval vessels. Consider—never, in the entire history of warfare, has a single bomb destroyed five ships in a single blast. Also consider that this bomb did not actually explode on a single ship. We don't know exactly how high in the air it exploded but before the test it was officially stated that it was to be detonated several hundred feet above the water and after the test, it was officially announced that the bomb exploded at the height it was planned to explode at. So the bomb exploded, probably, some 500 to 800 ft above the water. Yet it sank five ships.

But it did much more than that. In addition to sinking the five ships, it virtually wrecked another, seriously damaged five more and did light damage to half of the 73 vessels in the array. Keep in mind, a single bomb did all that. True, nearly all of these vessels could be put pack into service. Rear Admiral Solberg of the Bureau of Ships of the Navy Department, stated at a press conference today that even the battered and burned carrier *Independence* whose entire superstructure was swept away could be repaired in a matter of 9 months. As far as further action is concerned, these six badly damaged ships would have been out of action if this blast had occurred under battle conditions. So we can consider that this single blast put eleven ships out of action.

No Ordinary Force

No one who had the privilege of visiting the battleship *Nevada* last week before the blast and visiting her again today, as we did, could fail to be impressed by the enormous force that all but wrecked the superstructures of this great battleship. One should see her stack, crushed like so much cardboard and her twisted and stove-in bulkheads above deck to understand something of the force that did this.

This was no ordinary force. It was something so far beyond that produced by ordinary explosives that comparison becomes useless. The ex-German cruiser *Prinz Eugen* was anchored about halfway between the center and the outer edge of the array, probably a distance of some 2000 yards; yet, she was marked by whirls of blackened paint and had a wrecked wooden foremast.

No official information is available as to where the bomb actually exploded in the array but, from the shadows formed by the blast on various of the ships we had the privilege of visiting, and taking into consideration the location of the five ships that were sunk, it is quite obvious that the bomb landed at a point somewhere astern and on the starboard side of the Nevada and to the port and astern of the Independence. This was in the area where the ships were sunk.

There has been much speculation among the newspaper representatives in this group as to the exact height and location of the point of detonation. Actually, the exact point doesn't matter. Whether the bomb exploded 500 yards or 1000 yards from the *Nevada* or the *Independence* is of less importance than the knowledge that five ships were sunk and six wrecked by a single blast.

There has also been much speculation as to whether this bomb was as effective, that is as powerful, as the previous bombs exploded at Alamagordo, Hiroshima and Nagasaki. From the fact that the mushroom of this burst did not rise to the height that the Nagasaki mushroom did it has been felt that this bomb was weaker than the others. Admiral Blandy has issued a statement to the

effect that this bomb was somewhat less powerful than the bomb which exploded over Nagasaki but more powerful than the bombs exploded at Hiroshima and Alamagordo.

Pressure Developed by Blast

One of the effects very noticeable in this blast is the very steep pressure front developed by the blast. A large number of diaphragm type of pressure gages were set up on all of the ships. These gages consist of a steel box with varying size holes in each of the six sides. These holes were covered with aluminum foil. The smaller the hole the more would be the pressure required to rupture the foil. In examining these gages after the blast it was found that in most cases the foil in the holes facing the blast were all ruptured while those just around the corner—only a few inches away—were intact, in fact in many instances they were pressed outwards, indicating a reduction of pressure on those sides.

The pressure front also seems to have been very uniform. On the deck of the *Nevada,* for example, there were many delicate instruments, for example, fire control mechanisms containing many vacuum tubes. These mechanisms were not damaged at all, virtually none of the vacuum tubes were damaged; yet the entire deck on which this equipment was located, was depressed about 8 inches! This showed that there was not enough variation in pressure along the wave front to damage small parts but the pressure of the front as a whole was great enough to depress the entire deck of this battleship.

Effects and Meaning of Temperature

Much speculation has gone on in regard to the heat developed in the atomic bomb blast and the figure of 100,000,000 degrees is much quoted. Reporters even were concerned whether that figure was in terms of Fahrenheit or Centigrade! As a matter of fact, in evaluating the effects of the blast this figure can be dispensed with because, so far as the practical temperature effect on materials is concerned, a much lower figure should be used. These millions of degrees are figures used by the nuclear physicists to denote the absolute energy of the particles in the fission reaction.

When we speak of temperatures of hundreds of millions of degrees we refer to the energies of the individual atoms, not the temperature throughout the blast as a whole. The photographs of the blast last Monday from the special photographic towers on Bikini Island show the diameter of the instantaneous flash to be something on the order of a mile or more. Assuming that the energies of the individual atoms at the very center of the blast to be of the order of hundred million degrees, it must be obvious that this energy integrated throughout a sphere or hemisphere a mile or more in diameter will result in a temperature very much lower. Even at a distance of a few hundred yards from the center of the blast, the temperature of the flash probably is of the order of a few thousands of degrees.

It must be remembered that when we speak of temperature we are referring to the effect of radiant energy on matter. If there is no "matter" there can be no temperature. The heat and light which the earth receives from the sun comes to us across some 92 million miles of space. In that space, temperature, has no significance. It is only when the electromagnetic radiations from the sun encounter atoms of matter that we have what we refer to as heat or temperature. Temperature is a measure of the molecular agitation of molecules and atoms; it has to do with the speed of particles. The average speeds of the atoms and molecules of matter in ordinary states such as we are familiar with are relatively slow, even at temperatures of several thousands of degrees. In the fission of uranium, however, we are concerned with particles moving at speeds of tens of thousands of miles per second and if we express these speeds in terms of temperature we get values of the order of millions of degrees.

These high speed fission products, including the neutrons and electrons released in the process as well as the electromagnetic radiation represented by the loss of mass resulting from the fission, transfer their energies to the surrounding atoms, i.e., the atoms and molecules of air and the atoms of the material enclosing the bomb, and thus raise their temperature. Energy conversions only take place with a decrease of temperature and so as this process of energy transfer continues from atom to atom, the temperature becomes lower. Even a relatively short distance from the center of the initial reaction, therefore, the temperatures that exist are probably on the order of thousands of degrees rather than millions of degrees. At the distances that even the nearest ships were from the center of the blast the temperatures were probably much lower still.

Electromagnetic Radiation

The extremely high temperature inherent in the fission process of course lasts only a few millionths of a second. During that time, however, there is a burst of electromagnetic radiation—infrared, visible light, ultraviolet, x-ray and gamma radiation. When this *radiant* energy passes through the atmosphere it suffers absorption and thus heats the atmosphere in its passage. No doubt, most of it is absorbed in this way, that is in heating the air. Some of it, however, particularly the visible light, the infrared and portions of the ultraviolet frequencies get through and heat up the solid matter upon which it impinges.

It is this electromagnetic radiation that is responsible for the scorching effect of the blast. It is extremely intense but its duration is so short that its effect is superficial. This was noted at Hiroshima and Nagasaki, where it was found that even a thin shirt was sufficient protection against burning the skin of the men and

Fig. 5. Ships anchored in Bikini Atoll Lagoon, including both Joint Task Force One and target ships

women exposed to the direct flash. And it is reflected in the results of the Bikini test. On ships such as the *Nevada* and the *Pensacola* which were very close to the blast, the paint is seared and burned off the exposed surfaces but it is apparent that the penetration was very small.

Blast Bends a Lamp

An interesting effect was noted on the *Prinz Eugen*. There was an incandescent lamp bulb mounted on the outside of one of the forward gun turrets, directly in line with the blast. This bulb was not broken, but it was deformed—bent in the direction of the blast. Evidently, the instantaneous temperature was sufficiently high to cause the thin walls of the glass to become soft and so it became deformed. It would not have done this had the glass been thick but being very thin it could absorb sufficient energy to partially melt.

These facts concerning temperature and energy distribution are emphasized here because there seems to be little understanding of them by the newspaper representatives who witnessed the tests. Because physicists have referred to million degree temperatures laymen are likely to assume that such temperatures exist throughout the entire volume of the luminous burst. Such, obviously is not the case. As far as the temperature effect is concerned, it is evident that even a thin barrier of metal or wood or, in fact, any solid substance, would protect a person from burns.

This, however, does not imply that such barriers would protect against radioactive effects. These are more penetrating through solid matter than the visible and ultraviolet portions of the spectrum. Even several inches of steel is not sufficient protection against the extremely penetrating gamma rays. This will be obvious when one considers that such rays are used in industry every day for the examination of steel forgings and castings.

Effect on Animals

The fact that at least 75 per cent of the animal population aboard the vessels in the target array survived does not mean that a considerable number of them will not die during the next few weeks because of the radioactive effect. Already, it has been found that the blood count of many of these animals is going down.

The larger animals, the goats and the pigs, seem to have withstood the shock effect better than the smaller animals, the rats and mice. Since the chest structure of a goat is approximately comparable to that of a human being it follows that if there had been personnel aboard these vessels, many of them would have withstood the shock in the same way. It is too early, of course, to draw any definite conclusions but from an early examination of the evidence, it is apparent that all the personnel that might have been on board even such ships as the *Nevada*, would not have been killed.

Fig. 6. The *U.S.S. Independence*, shortly after the atom bomb explosion, bears little resemblance to the ship that entered Bikini Lagoon a few days earlier

In evaluating the results of the Bikini test it must be understood that the purpose of the test was to obtain data on the effect of an atomic bomb explosion on an array of naval vessels. It was not a question of sinking the entire fleet or even an appreciable proportion of it. What was wanted was test data—data in regard to pressures, temperature, radiation effects throughout the target area. Also, it was desired to know the biological effect of the blast on animals and plants and what effect, if any, on the geologic structure of the atoll.

From this standpoint, there can be no doubt that the test was highly successful. Thousands of instruments were disposed throughout the area and when the readings of these instruments are classified and analyzed, we will know a great deal more about the actual effect of atomic blast than we did before.

Precision of Test

Perhaps the most remarkable thing about this test was the precision with which the whole operation was carried out. The test was not only carried out on the first day it possibly could have been carried out, i.e., July 1, but the bomb was detonated at the exact instant that it was planned to go off. The time had been set for 0900 hours. The bomb exploded exactly at 9 o'clock, not one or two seconds before or after nine but exactly at 0900. And, it was detonated, without much doubt, within 1000 yards of the designated target, quite probably at about 500 yards.

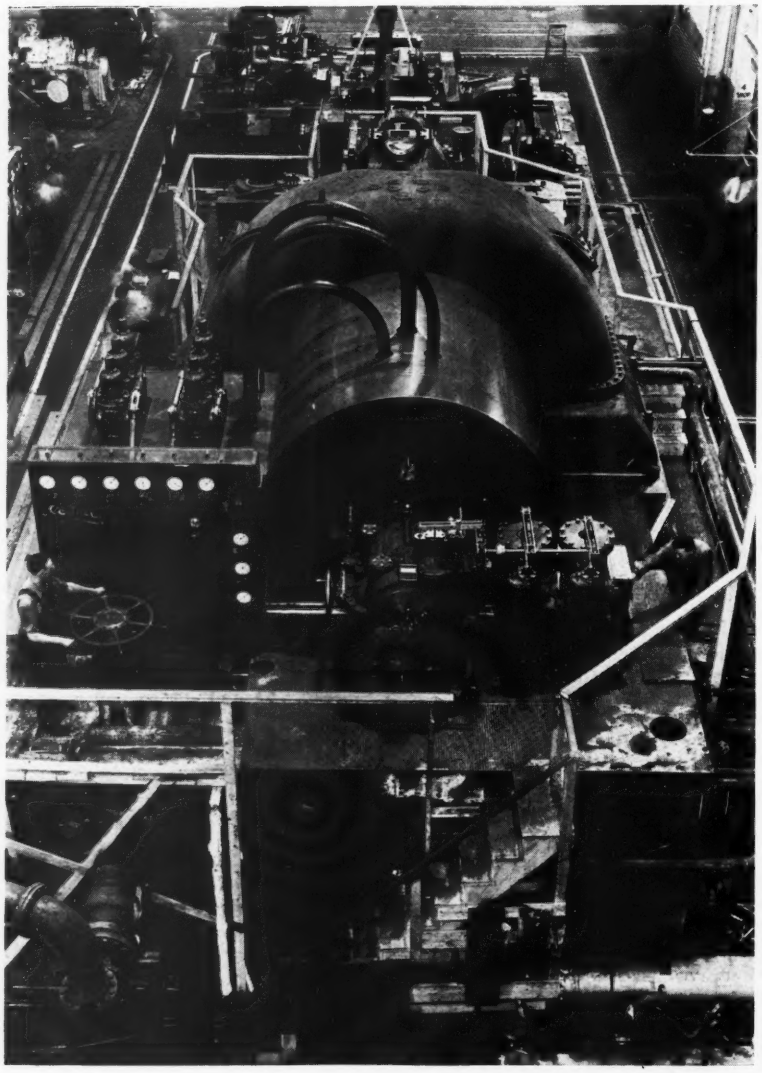
Furthermore, all other parts of the operation were carried out with similar precision. The drone planes were sent through the radioactive cloud just as had been planned and only one of these radio-controlled planes was lost. Something went wrong with the controls of this machine and it was lost in the ocean. One other drone went out of control temporarily but the pilot in the mother plane followed it some 55 miles out at sea and recovered it, bringing it back to Kwajalein along with the others.

My own personal reaction to the test, at first was one of slight disappointment. At the distance of 18 miles which the Appalachian was from the blast, it was not as spectacular as most of us had expected. Yet, after having seen the evidence of what this blast did, I am much more impressed. It is quite obvious that no force like this has ever been produced by man. To think that a single bomb could sink five ships, wreck six and damage some 25 others, is almost beyond belief.

Now, we are waiting for test Baker to be carried out. In this test, the bomb will be detonated in shallow water, that is just underneath the surface of Bikini lagoon. Nearly everybody expects this to be more destructive than the test carried out last Monday in which the bomb was exploded in the air.

Fig. 7. Sailors watching the atomic bomb cloud from a ship many miles away

Modernizing Rockford, Illinois,



BOTH turbine generators are rated at 20,000 kw, 80 per cent power factor, and are 3600 rpm, 60 cycle Allis-Chalmers machines generating 3 phase current at 13,800 v. Shop assembly pictures of the first unit are shown in Fig. 14 and a section through the turbine is shown by Fig. 15. There are two rows of impulse blading followed by 25 rows of reaction blading. In the first unit, the last ten rows are 13 per cent chrome and the other rows are "Cyclops" material. In the second unit, all reaction rows are 13 per cent chrome with "Cyclops" material used only in the two rows of impulse blading.

The turbine design conditions are 650 psi, 825 F at the throttle and 1½ in. Hg at the exhaust with extraction at three points for normal feedwater heating and provision for extraction at a fourth high pressure point during light load operation to prevent water entering the economizer below 250 F and to keep the pressure in the deaerating heater above atmospheric. Additional steam may be extracted from each turbine to heat 75,000 lb per hr of foreign condensate, i.e., condensate from existing low pressure turbines receiving steam from the high pressure boilers through a pressure reducing and desuperheating station.

Each generator will have a direct connected main and pilot exciter, integral housing type surface air coolers and CO_2 fire control apparatus.

The units will be equipped with turning gear, individual Bowser lubricating oil purification systems, and two motor driven lubricating oil pumps in addition to the pump driven through gearing from the main turbine shaft, the separate steam driven pump and the two high pressure motor driven pumps that are used to lift the main shaft off the bearings before starting the unit.

Fig. 14 (above). This is a shop view of one of the turbine generators. Both of the newly installed units are rated at 20,000 kw, 80 per cent power factor and are 3,600 rpm, 60 cycle, Allis-Chalmers machines which generate 3 phase current at 13,800 v

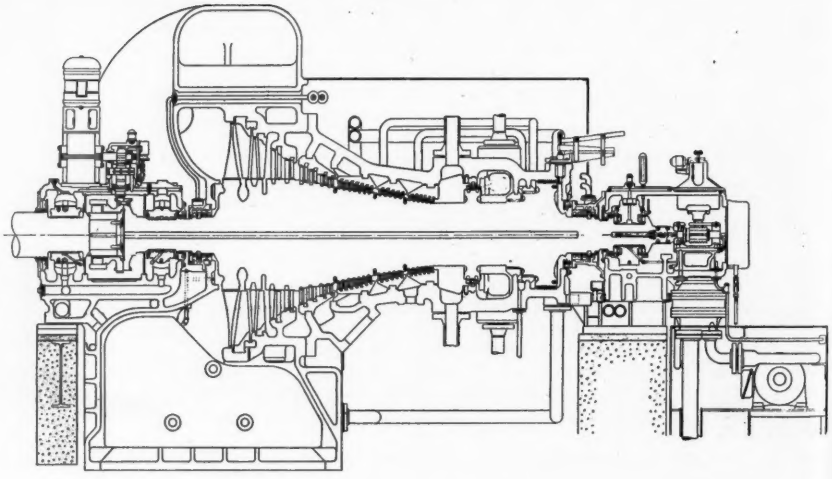


Fig. 15 (right). This is a section through the No. 9 unit turbine. There are two rows of impulse blading followed by 25 rows of reaction blading. In this unit the last ten rows are 13 per cent chrome and other rows are "cyclops" material. "Cyclops" material is used in only two rows of impulse blading in the second unit

s, Generating Station • • • • •

By W. E. Hopkins, and *R. S. Kibler,*

Mechanical Engineer, Stone & Webster Engineering Corp.

Chief Engineer, Central Illinois Electric & Gas Co.

Part II. In the first part of this article in the July issue, the authors described that part of the project involving the steam generating equipment. Now they describe the turbogenerators, condensing water and feedwater systems, electrical system

In addition to the protection provided by the four oil-actuated, non-return extraction valves against back flow of steam into the turbine, a solenoid operated pilot valve will be installed in the oil line to each non-return valve to protect the turbine against return of water from the feedwater heaters.

The proposed operation of the plant as an isolated station has led to the use of the conventional atmospheric relief valve arrangement instead of the low vacuum trip apparatus now frequently accepted where ample rotating reserve capacity is available through electrical interconnection with other stations.

Feedwater System

The normal boiler feed supply for the high pressure boilers will be condensate from the high pressure turbines supplemented by condensate from the existing low pressure plant. Emergency make-up will be treated river water.

Fig. 16 shows a flow diagram of the principal steam and water lines for the entire plant and includes an approximate heat balance for a cold winter day after installation of the new boilers, Nos. 11 and 12, and the new turbine generators, Nos. 9 and 10.

Two motor driven and one steam turbine driven boiler feed pumps are being provided for the new boilers. The pumps are being furnished by the Worthington Pump and Machinery Corp. and will have 5 to 6 per cent chrome casings. The turbine driven pump will be stand-by for either motor driven pump and will automatically replace either pump upon lowering of pressure in the boiler feed header. Since the deaerating heaters which supply the pumps operate at varying pressures depending upon the turbine loads, it is necessary to have individual pump suction leads. Fig. 17 shows the arrangement of electrically operated valves required to secure automatic selective operation.

Continuous blowdown from the new boilers can be fed to the deaerating heaters to decrease the purity of the water handled by the boiler feed pumps.

The boiler feed pumps and extraction heaters are all designed for handling not only condensate from the new turbine generator units but also condensate that would likely be returned to the high pressure plant by the low pressure plant if a pressure reducing and desuperheating tie is installed between the 650 lb and 250 lb steam headers.

An unusual feature of the plant design is the location of the boiler feed pumps and extraction heaters in the turbine room instead of the boiler room because of the difficulties and cost that would be involved in running turbine extraction leads under the railroad right-of-way to the boiler room.

A condensate storage and transfer tank of a capacity equal to the water content of the largest boiler will be installed in the turbine room basement. This tank will serve as a surge tank in the transfer of condensate from the low pressure plant to the high pressure plant as indicated by the condensate flow diagram shown on Fig. 18. It will also receive drips and drains from the new turbine generator units. The tank will have two compartments to facilitate cleaning without interrupting operation of the high pressure plant.

Two small horizontal pumps will be provided alongside the tank for handling normal make-up to the deaerating heaters. Two larger vertical pumps will be installed on top of the tank for handling condensate transfer in greater quantities.

The boiler feed regulators will be the Copes Flowmatic two element type and will be located near the boiler room operating floor for quick access.

Each turbine will exhaust into a 17,350 sq ft Allis-Chalmers, two pass, divided water box surface condenser. Each condenser will be equipped with two motor driven condensate pumps and a two stage, twin element air ejector.

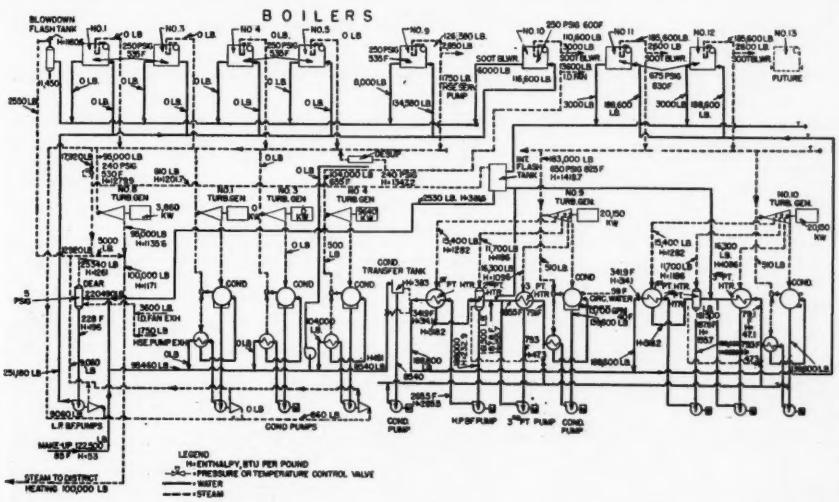


Fig. 16. This flow diagram of the principal steam and water lines for the entire plant includes an approximate heat balance for a winter's day after installing the Nos. 11 and 12 boilers and the Nos. 9 and 10 turbine generators

Circulating water for the two condensers will be provided by two adjustable vane, vertical, motor driven, constant speed, Ingersoll-Rand axial flow, propeller type pumps. Each pump will have a rating of 20,000 gpm at about 20 ft total dynamic head. The pump size was chosen so that each pump could supply the circulating water requirements of one of the main condensers. Reduced flow will be obtained through push button control of the adjustable vane settings for the many variations that will occur in the static head available between the headrace and tailrace water levels.

The pumps will be installed in an extension to the hydro plant as indicated on Fig. 3 (Part I of article). Two 36 in. steel pipe discharge lines will be carried on a pipe bridge across the tailrace and under the turbine room basement to the condensers. The condenser outlet lines will join in one 48 in. pipe that will discharge into the tailrace.

Although circulating water will normally be obtained from the headrace, a large 48 in. by 96 in. iron gate has been provided in the pump intake chamber to permit use of water direct from the river in case the headrace were dewatered purposely for repair or unexpectedly due to breakage of the retaining walls.

An exceptional feature of the cooling water system is the arrangement shown on Fig. 19 for discharging the cooling water from the generator air coolers to the water treating plant instead of to waste as is normal practice. This arrangement is attractive in this case despite the precautions that must be taken to protect the generator air coolers as the water treating plant demands are large during the district heating season and the cooling water will be much cleaner than the present river water supply. At the start of the project a study was made as to whether condensate, well water or strained river water should be used for the generator air coolers. A Cuno self-cleaning type strainer has been developed to handle 2000 gpm with a 2 lb pressure drop and will be installed with automatic stand-by service from the existing house service water system.

Electrical System

Generation is at 4000 v nominal for local distribution and at 13,800 v for feed to outlying substations. The two systems are tied together near the 13,800-v outdoor substation through two 8000 kva transformer banks. Due to the availability of the hydrogenerators, most of the station auxiliaries are motor driven. 13,800-v power is also available from a substation which has a tie line connection to the lines of the Public Service Co. of Northern Ill. Fig. 20 shows a one line diagram for the Rockford Generating Station.

Generator and feeder cables were routed to the outdoor 4-kv switchyard and 13.8-kv switchyard through underground ducts which traversed the area to be covered by the extension to the turbine room and therefore had to be relocated temporarily during construction. A tunnel along the west wall of the turbine room will be the permanent location of cables, but during construction, the only space available was through the 4-kv outdoor switchyard. Owing to congestion it was not feasible to install more underground conduit in the yard and it was therefore determined to build a wooden duct system on the ground, using plank top and bottom and board separators with a walk on top to provide space for operating disconnects, etc.

This structure was erected one tier at a time as the cables were laid in, and fire protection was furnished by 1½ in. perforated water pipe installed near the structure for its entire length and connected through a valve to the water main.

Considerable new underground conduit has been installed to take generator and feeder cables from the south end of the turbine room tunnel to the 13.8-kv switchyard and also to connect to the turbine room and boiler room station service switchrooms. Ducts have also been provided for 13.8-kv feeders, getting away toward the east.

The control cables to the outdoor switchyards also ran underground in the path of the building extension and had to be relocated. This was accomplished by building a steel conduit rack along the west wall at an elevation to bring it just under the switchboard gallery. This rack consisting of over 100—1½ in. conduits was supported on the building columns in the existing building and had temporary cantilever supports from the 4 kv substation steel to the end of the extension with provision for fastening to the building columns after their erection. Beyond the end wall, the conduits were carried on a steel support for a short distance and then turned down to enter the top of a manhole which was enlarged to take care of this entrance.

The 13.8-kv outdoor substation was being outgrown and the existing equipment was inadequate to withstand the short circuit stresses that would be possible with the increase

Fig. 17. This drawing shows the arrangement of the electrically operated valves which are required to secure automatic selective operation

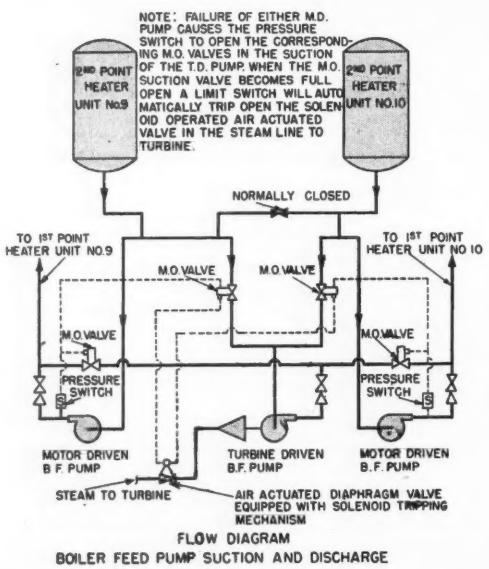
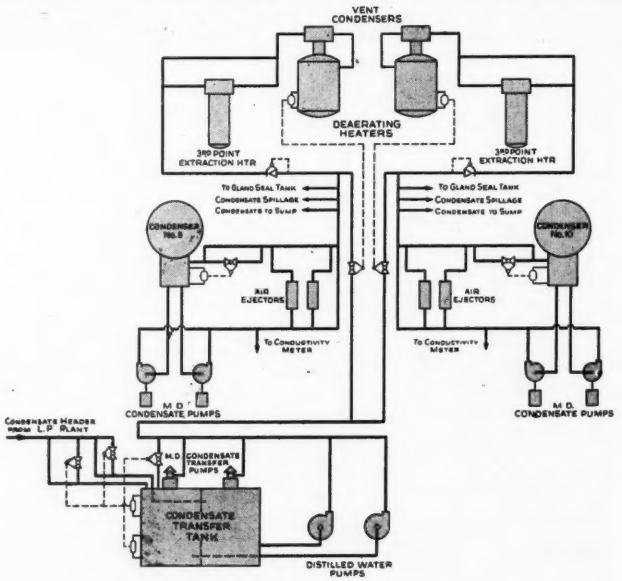
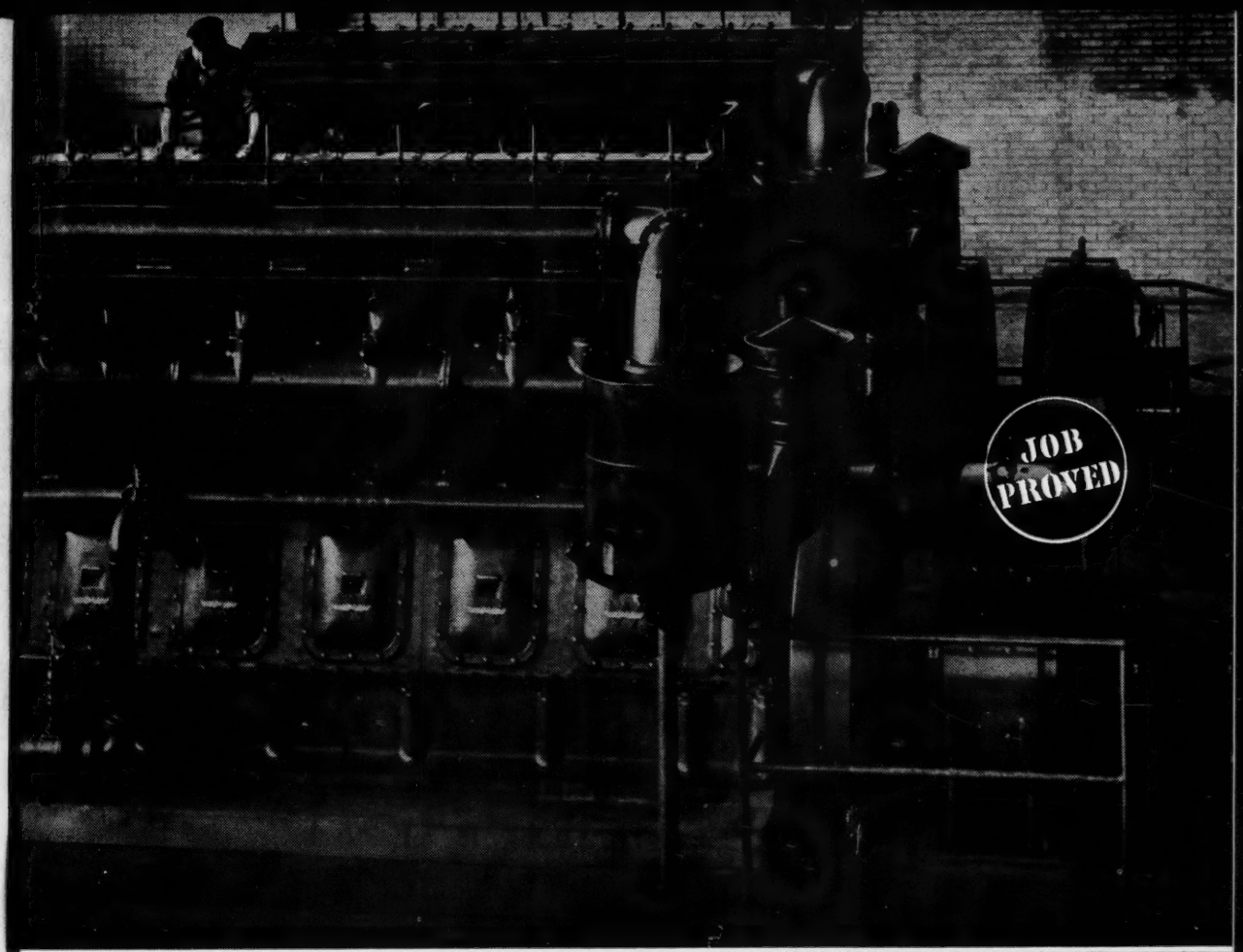

NOTE: FAILURE OF EITHER M.D. PUMP CAUSES THE PRESSURE SWITCH TO OPEN THE CORRESPONDING M.O. VALVES IN THE SUCTION OF THE T.D. PUMP. WHEN THE M.O. SUCTION VALVE BECOMES FULL OPEN A LIMIT SWITCH WILL AUTOMATICALLY TRIP OPEN THE SOLENOID OPERATED AIR ACTUATED VALVE IN THE STEAM LINE TO TURBINE.
2ND POINT HEATER UNIT No.9
2ND POINT HEATER UNIT NO.10
NORMALLY CLOSED
TO 1ST POINT HEATER UNIT NO.9
TO 1ST POINT HEATER UNIT NO 10
M.O. VALVE
M.O. VALVE
M.O. VALVE
M.O. VALVE
PRESSURE SWITCH
PRESSURE SWITCH
MOTOR DRIVEN B.F. PUMP
TURBINE DRIVEN B.F. PUMP
MOTOR DRIVEN B.F. PUMP
STEAM TO TURBINE
AIR ACTUATED DIAPHRAGM VALVE EQUIPPED WITH SOLENOID TRIPPING MECHANISM
FLOW DIAGRAM
BOILER FEED PUMP SUCTION AND DISCHARGE

Fig. 18. The condensate storage and transfer tank shown in this condensate flow drawing has a capacity equal to the water content of the largest boiler. It will serve as a surge tank in the transfer of condensate





Beating AN OIL-THROW PROBLEM

SUN LUBRICANT . . .

Stays On the Bearings and Off the Generator Coils; Bearing Temperatures Drop 10°

A manufacturer found that the coils of his generators were being coated with a fine spray of oil leaking from the bearings.

Serious injury to coils and a complete shutdown of the power plant could be possible if the situation were not remedied.

A Sun Engineer studied the problem and suggested a "Job-Proved" Sun lubricant, one that had been used successfully on hundreds of bearings under similar operating conditions.

The oil-throw problem was solved when this recommendation was adopted. Further investigation showed that bearing temperatures had dropped 10°F. As a result, Sun oils have been adopted for all ring-oiled motors and generators in this plant.

For all types of power generating equipment— for Diesels, turbines, steam engines, or electrical units — "Job-Proved" Sun lubricants are highest assurance of long life and continuous operation.

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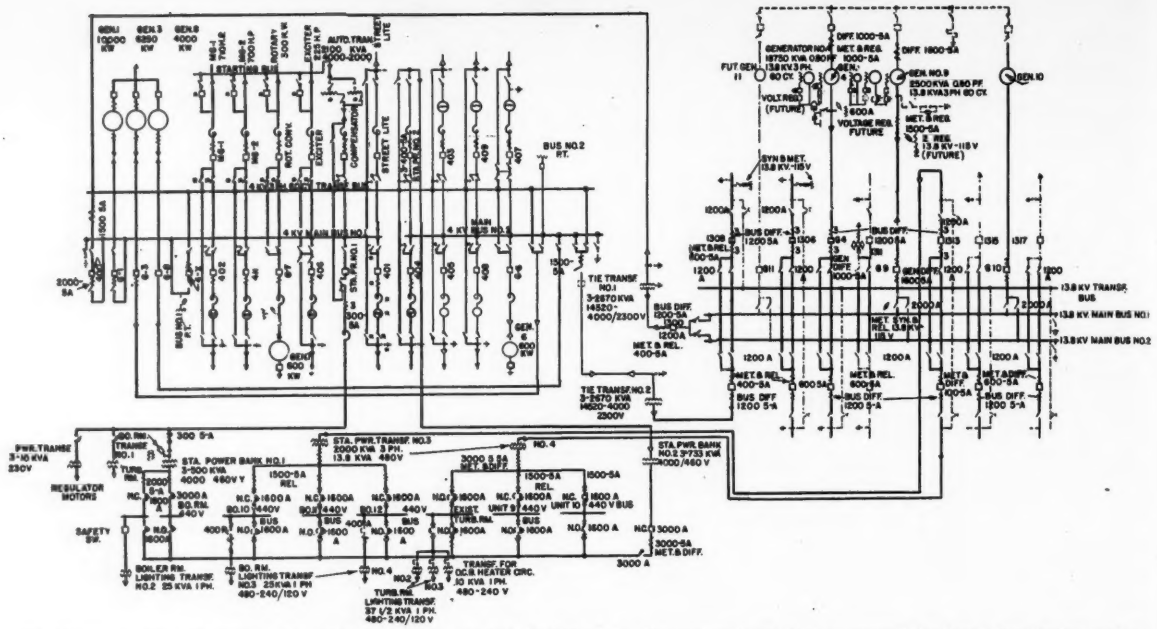


Fig. 20. A one-line diagram of the electrical system at Rockford Station. Generation is at 4000 v nominal for local distribution and at 13,800 v to feed to outlying substations. The two systems are tied together near the 13,800-v outdoor substation through two 8000 kva transformer banks

in generating capacity. Steel was obtained for an extension to the substation structure and new equipment was purchased for the entire station. The buses in the extension are to be connected to the buses in the existing structure by flexible connections which could be taken off to separate the two sections during changeover. The changeover is being made by (1) erecting and completely equipping the new extension structure, (2) temporarily transferring to positions on the new structure the generator leads and the outgoing feeders, (3) deenergizing and stripping the existing structure and installing permanently all new equipment, (4) connecting through the buses and reinstalling the incoming and outgoing circuits in their permanent locations.

This substation uses the double bus arrangement with gang operated selector disconnecting switches and oil circuit breakers having an interrupting rating of 1,000,000 kva. The station is also designed for a transfer bus, but the switches for this bus are not being installed at present.

A new 13.8-kv control board is being installed for the control of all new 13.8-kv generator and feeder circuits and will be extended later to care for existing 13.8 kv circuits.

The existing station service load is carried by a transformer bank and 440-v switchboard for the turbine room and a transformer bank and 440-v switchboard for the boiler room, both transformer banks being fed from the 4000 v system. Two tie lines connect the switchboards which are arranged so that normally each switchboard and transformer bank carries approximately one-half the turbine room load and one-half the boiler room load with automatic throwover in case of failure of one bank.

The new station service load requires a new transformer and switchboard at the turbine room and a new transformer and switchboard for the boiler room. These transformers will be fed from the 13.8-kv system. The new switchboards are metalclad 440-v with sectionalized buses and drawout type of air circuit breakers. There will be one emergency tieline connecting all station service switchboards which will be fed by the existing transformer bank at the turbine room which will have most of its present load transferred to the new turbine room switchboard.

Loss of voltage on any section of bus on any station service switchboard will automatically cause that section to be disconnected from its usual source and connected to the tie bus. Re-establishment of the original connections will be done through manual operation after the trouble has been cleared. Loss of voltage on the tie line will cause its connections to be changed to another transformer.

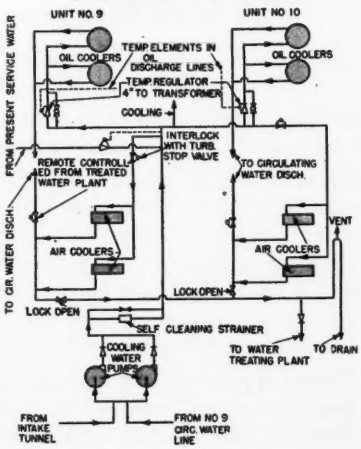
Differential protection is being provided for the 13.8-kv substation and surge protection is being provided for the existing 15,000 kw 13.8-kv generator.

Leeds & Northrup multiple point, Micromax, electric thermocouple type instruments will be installed for recording gas, air, steam, water and oil temperatures, as well as condensate conductivity and per cent CO_2 in the boiler flue gases. Other instruments being furnished are—Cochrane electric type steam and water flow and pressure recorders, Bailey level recorders, Hays pointer type draft gages, Crosby pressure gages and Taylor & Weston thermometers.

A central gage board will be provided in the boiler room for both new boilers with provision for extension to include one existing boiler and a pressure reducing station tie between the high and low pressure plants. Similarly, a central gage board will be installed in the turbine room for both new turbines, the new remotely controlled circulating water pumps, and all high pressure boiler feed equipment. The boiler room gage board will be painted lettuce green while the turbine room gage board will be painted a deep ivory to harmonize with the turbine room color scheme.

The power plant enlargement and modernization is being designed and constructed by Stone & Webster Engineering Corp.

Fig. 19. This drawing of the cooling water system shows the unusual arrangement for discharging the cooling water from the generator air coolers to the water treating plant instead of to the waste



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Edward cast and forged steel blow-off valves are built to withstand these conditions — without bulky metal sections that add to weight and cost and distort in service and without additional special parts that complicate maintenance.

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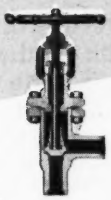

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Coefficients of expansion of materials are such that an Edward valve closed tight at high temperature is still tight when cooled.

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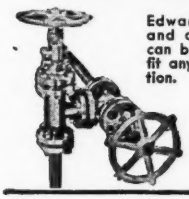

Edward straightway and angle designs can be combined to fit any space limitation.

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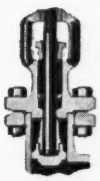

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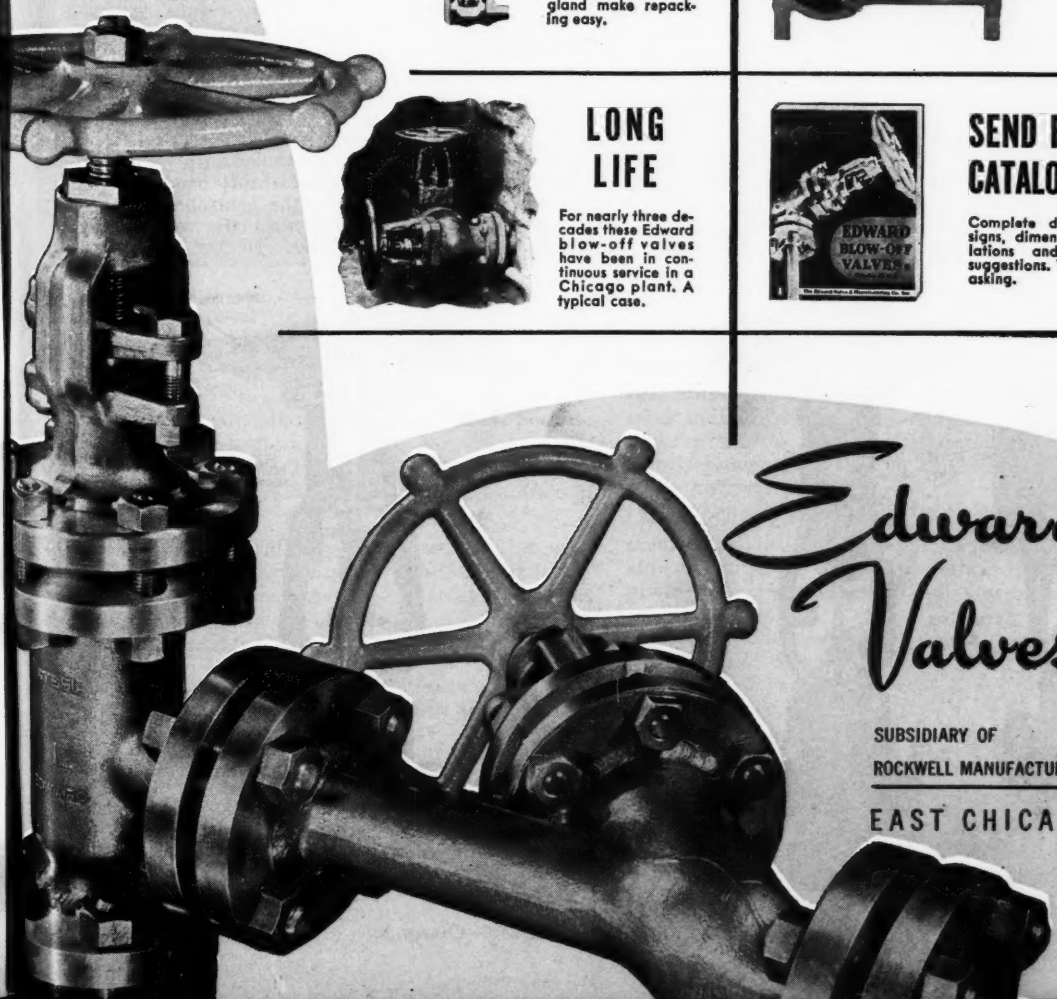

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WHY DESIGN DETAILS ARE IMPORTANT IN Motorized Control Valves

Part I—This is a comprehensive analysis of the design of motorized control valves of the sliding-stem type. It provides operators with all the information necessary to properly select these valves for any type of service. The author considers both the power unit and the control valve itself. In this part of the article the power unit is discussed, showing how its design affects proper operation of a control system. The control valve itself will be considered in Part II to be presented in the next issue

By **S. D. Ross** *Engineer, Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co.*

BASICALLY, the motorized valve assembly discussed here comprises: (1) a power unit which is operated by the controller to position a sliding stem in accordance with the controlled variable (temperature, pressure, etc.), and (2) the control valve containing a variable opening which will regulate the control agent (steam, gas, etc.) in accordance with the valve stem position. The two units, usually with a stuffing box between, to seal the control agent in the valve body, make up an assembly such as shown in Fig. 1a or 1b for typical electrical and pneumatic types.

The Power Unit

Power units of either the electric or pneumatic type fall into two classifications according to the type of controller used, namely: (1) two-position or on-off, and (2) proportional (throttling) with or without floating action (automatic reset). For proper operation of the valve, either class must provide ample power and proper lift. In addition units for proportional control valves should maintain a substantially linear relation between stem travel and pen movement of the controller.

Basic Operating Principles

Electric power units generally comprise an integral housing containing the motor proper and a gear reduction unit to amplify the torque. For two-position control the motor is energized through a high or low contact in the controller to rotate the motor shaft to one of two extreme positions of travel. For proportional control the motor is operated through a slidewire or other balancing circuit, so that, within the proportional band (throttling range), each position of the instrument pen has a corresponding angular position of the motor or gear shift.

By means of a cam or other linkage, rotary motion of the gears is converted into linear motion of an output shaft connected to the valve stem. Several timings for full travel are usually available with these motors—such as 15 or 30 seconds, or longer—to suit the application.

The pneumatic power unit or diaphragm motor, one type of which is illustrated in Fig. 2, has a flexible diaphragm with a pressure-tight chamber on one side to which air output of the controller is connected. On the other side of the diaphragm is placed a compression spring assembly. A rod rigidly fastened to the metal plate under the diaphragm is directly connected to the valve stem.

Air pressure applied on the top of the diaphragm creates a downward force (diaphragm force) equal to the product of air pressure multiplied by the area of the diaphragm. As the diaphragm moves downward, the spring further compresses and creates an opposing upward force (spring force) which, when equal to the downward force, results in a balanced position of the diaphragm and, consequently, a balanced position of the valve stem.

For proportional control, this arrangement provides intermediate positioning of the valve stem for each value of controlled air pressure within the proportional band (throttling range) of the controller. For two-position control the same arrangement is used. In this case, however,

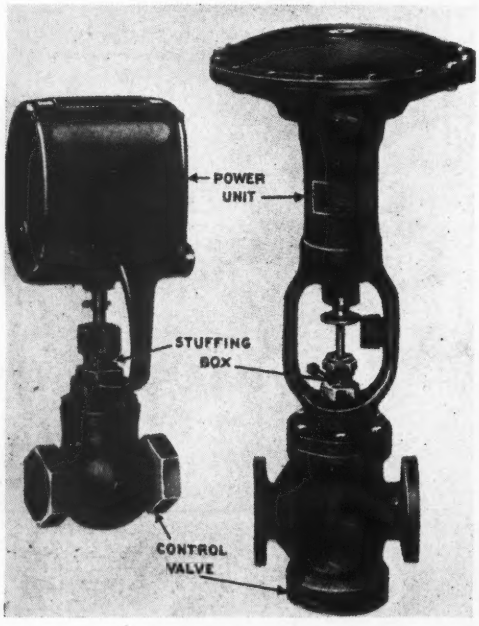

Fig. 1—Left. Typical electric and pneumatic globe type valve assemblies, a. electric, b. pneumatic

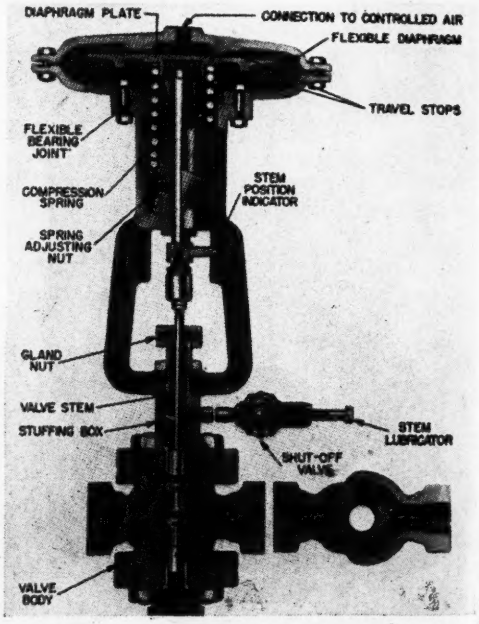

Fig. 2 — Right. Typical diaphragm motor valve for proportional control

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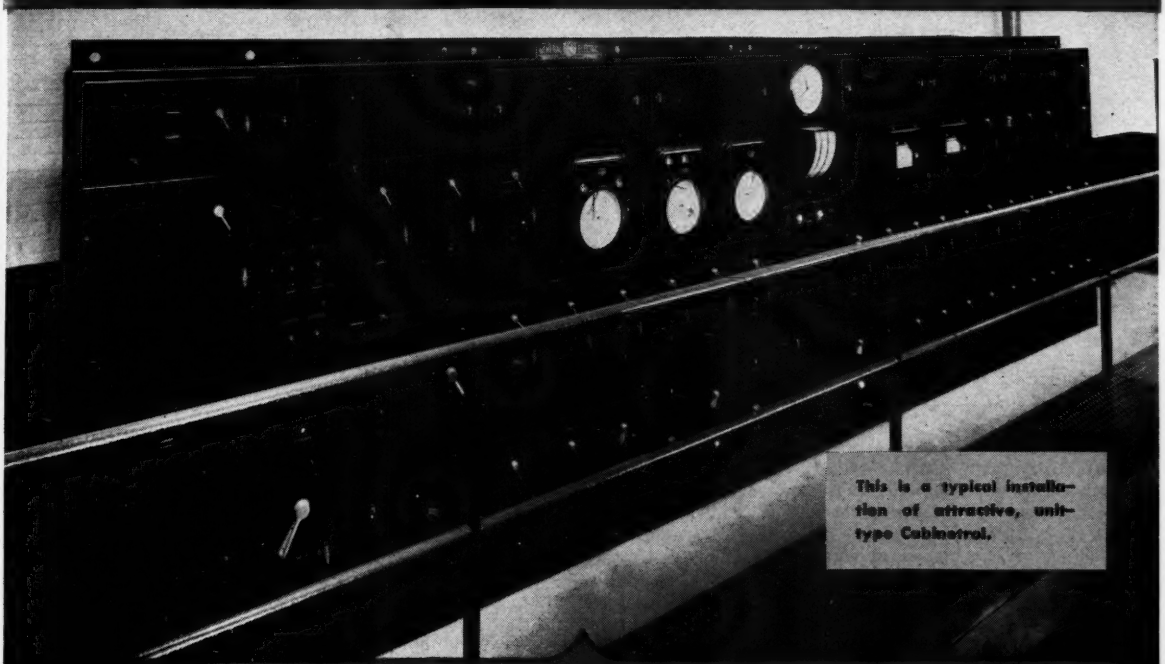

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controlled air pressure is either at a maximum or minimum value to position the valve stem in one of the two extreme positions of travel.

Power

In order to position the valve stem as demanded by the controller, the power unit must be capable of overcoming the forces of: (1) friction opposing motion of the valve stem and (2) thrust on the valve plug caused by pressure of the fluid flowing through the valve. These forces have their source chiefly in the stuffing box or the valve body and vary widely with the application.

The power unit is chosen to meet the most unfavorable combination of these forces. It is for this reason that the units are available in a number of sizes with different power ratings. Although valve assemblies are usually supplied with one size motor for several consecutive valve sizes, the power units are interchangeable so that if the application requires it a larger unit can be supplied in place of the standard size.

For proportional control the ability of the power unit to overcome friction and valve stem thrust in order to establish a new stem position, as demanded by the controller, will affect the closeness of control obtainable. With electric motors, the smallest change in the measured variable which will cause motion of the motor results in a considerable force acting on the valve stem.

The diaphragm motor, having the diaphragm force balanced by the spring force, however, has only the force available due to the change in controller air pressure which is proportional to the change in the controlled variable. This consideration emphasizes the importance of furnishing the diaphragm motor to suit the application.

Where a large amount of friction or valve thrust appears likely in the valve application and close proportional control is desired, the use of a valve positioner is always recommended with a diaphragm motor. Fundamentally, this device comprises an auxiliary air pilot system which either applies full air pressure (usually 15 or 30 psi) on the valve diaphragm, or exhausts air from the diaphragm until the valve stem is positioned as called for by the controller output pressure. Small changes in controller output pressure thereby cause maximum force to overcome resistance to repositioning of the valve stem. With this device positioning down to thousandths of an inch of movement is possible.

Use of the valve positioner with diaphragm motors is particularly advantageous on large size valves, or where a wide proportional band adjustment of the controller is necessary. It has also found application for proportional control where accurate positioning of small valves with low lifts is required.

A pneumatic control system incorporating a valve positioner is more strictly analogous to the electric control system. As in the pneumatic operation with valve positioner just described, the balancing means in the electric motor is generally connected directly to the output shaft and the motor is rotated in response to the controller action until the output shaft is correctly repositioned, in spite of stuffing box friction or other resistance to stem motion.

Although the diaphragm motor may have some limitations not found in the electric motor for proportional control, this should not be interpreted to indicate definite superiority of the electric motor. The overall responsiveness of the control systems must be considered. Practical design of the balancing means in the electric system, regardless of load on the motor, limits the maximum number of intermediate positions of the motor shaft within the proportional band. Diaphragm motors under no load inherently provide three to four times the number of intermediate positions available from electric motors.

Further, the diaphragm motor can be sized adequately for the amount of opposing stem forces found in many applications, so that the pneumatic system still surpasses the electric system in the number of intermediate positions obtained. If used with a valve positioner, the diaphragm motor can provide as many as ten times the number of positions obtained from the electric system, in spite of relatively high opposing stem forces.

Lift

For two-position control, in which the power unit moves the valve stem to one of two limiting positions, it is obvious that only a small movement of the stem for full travel, or low lift, is required. The minimum lift permissible is the necessary movement of the valve plug to its open position where the plug does not restrict the maximum flow as determined by the port area. Lifts vary with the size of the valve, being in the nature of ¼-in. for a ½-in. (S.P.T.) valve as compared to ¾-in. for an 8-in. valve.

For proportional control the power unit must position the valve stem accurately at intermediate points between the open and closed positions, so that a relatively "high lift" is required. Here again the lift varies with the valve size. A ½-in. valve for proportional control may have a lift of 7/16-in. as compared to 2-in. for an 8-in. valve.

Various lifts are obtained in electric motors by means of a cam or other linkage connected to the output shaft of the gear train. For either two-position control or proportional control, when valve stem movement is to be limited for a minimum or maximum flow instead of fully off or fully on, certain motor designs incorporate adjustable limit switches to stop rotation of the motor shaft. Such switches also provide a second means of varying the lift.

With diaphragm motors the lift is determined by: (1) the compression rate of the spring, in accordance with the desired lift and type of control required, and (2) travel stops within the diaphragm head casting, Fig. 2.

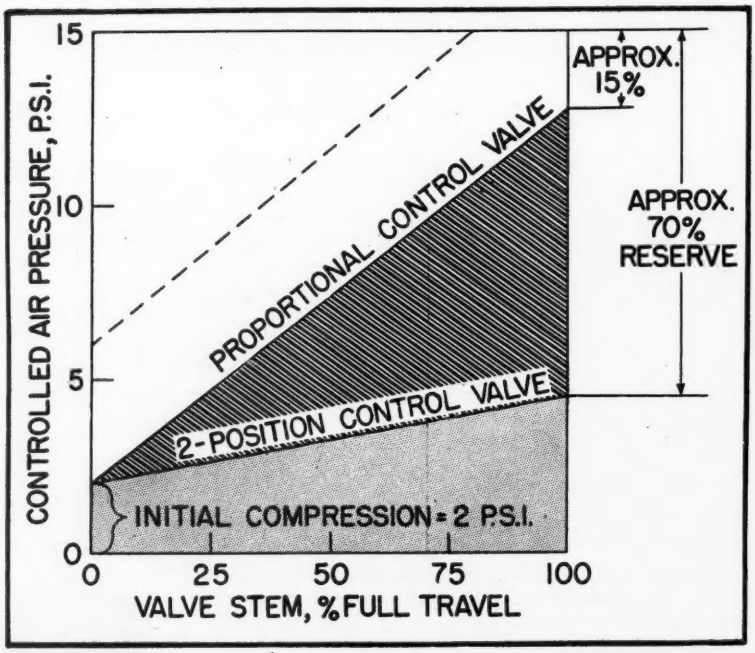

Fig. 3. Relationship of controlled air pressure and stem motion for two-position and proportional control

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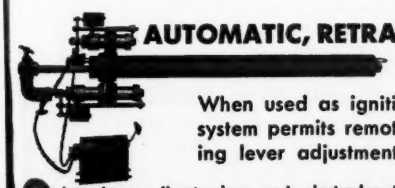

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For two-position control, springs of relatively low compression rate are used, as contrasted to springs in diaphragm motors for proportional control. In two-position control the action of the spring is simply to provide sufficient initial compression to counteract the weight of the diaphragm plate assembly and to insure positive movement of the valve stem to the upper end of stroke. It is advantageous to reserve most of the force from the controlled air pressure for the lower end of stroke where the valve plug must be seated or unseated against the maximum thrust of line pressure. The compression rate of the spring is selected therefore so that only about 30 per cent of the air pressure range acts against spring resistance to provide full stem travel, with the remaining 70 per cent as reserve.

For proportional control, the diaphragm motor must provide positioning of the valve stem at intermediate points of travel over as much of the controlled air pressure operating range as possible. The majority of diaphragm motor valves for such control utilize the double-port valve body construction in which the effects of line pressure thrust are minimized. The reserve force at the lower end of stroke, therefore, can be relatively small. In general, the compression rate of the spring in this case is selected so that about 85 per cent of the air pressure range acts against spring resistance to provide full stem travel, while 15 per cent is reserved for positive positioning at the lower end of stroke.

In certain applications of diaphragm motor valves for proportional control, it is desired to operate two valves from a single controller such that one valve is moved through its full travel over only a portion of the controlled air pressure range, and the other valve is moved through its full travel over another portion of the pressure range. Although such operation can be accomplished by proper choice of the spring compression rate and amount of initial compression in each valve, the use of a valve positioner with each valve is usually advantageous. The latter method utilizes valves of standard spring ranges, involving only simple field adjustments in the positioners. It also permits changing the operating range of each valve and assures positive positioning, in spite of opposing forces of friction or line thrust. Such an arrangement is mandatory for split range operation of large size valves.

The relationship between instrument controlled air and motion of the stem in diaphragm motors for two-position and proportional control is shown graphically in Fig. 3. Adjustment of the initial compression is made by means of a screw, such as shown in Fig. 2, which compresses the spring and increases the upward spring force holding the diaphragm against the upper travel stops. It will be noted in Fig. 3 that the initial compression determines the value of controlled air pressure at which stem travel starts. With a spring of a given compression rate (indicated on the graph by the sloping line), end of travel will be reached a fixed increment of pressure above this value.

If the initial compression is increased too greatly the final value of controlled air pressure necessary to provide complete travel may exceed the maximum air pressure obtainable from the controller. Full travel could not then be reached. This condition is shown by the dashed line starting with an initial compression of 6 psi instead of 2 psi. When the controlled air pressure reaches 15 psi, the stem has moved to only about 80 per cent of full travel. Further, the graph shows that increase of the initial compression decreases the reserve force at the upper end of travel.

Stem Travel Versus Pen Movement

For proportional control, the power unit acts as a relay to translate energy or valve positioning force created by the controller into respective stem travel. Proportional controllers are usually designed to provide essentially a linear relationship between the instrument pen movement and the corresponding valve positioning force. With a linear scale for the measured variable, this results in a constant rate of change of the positioning force with change in measured variable—a condition generally assumed when considering the controller operation.

The change of stem position for a given pen movement will remain constant over the full stem travel. It does not necessarily follow, however, that the desired relationship between the valve lift and the rate of flow should be linear.

In electric-operated proportional controllers, linear change in valve positioning force with pen movement is maintained by use of a uniformed transmitting means for the proportional action. The electric motor must then translate this into correspondingly uniform rotation of the gear train. The cam or other linkage connection to the valve stem must in turn provide a constant rate of linear motion with rotation of the gears.

With air-operated proportional controllers, the air pressure output in relation to pen movement is usually linear within plus or minus 4 per cent. In the absence of excessive friction and stem thrust, the diaphragm motor has been shown to be basically suited to translate the controlled air pressure on the diaphragm into corresponding valve stem positions on a linear basis. It will be noted, however, that the effective diaphragm area and spring compression rate must be constant over the range of stem travel.

For maintenance of the desired linear relationship it is also necessary to have consistent positioning of the valve stem for a given pen position, regardless of whether the position is the result of upscale or downscale movement of the pen. Any difference in this position is known as the hysteresis of the control system. The chief source of this unfavorable effect is friction in the stuffing box and valve stem thrust, not the controller or power unit itself.

(Part II discussing the control valve will be presented in the next issue.)

Boiler Scale Removal

(Continued from page 77)

water by steam injection prior to introducing the solvent is the preferred method.

When a good source of water is not available for direct pumping into the boiler as outlined above, it will be necessary to dilute the concentrated solvent to the proper concentration before it is pumped into the boiler. Under such conditions tankage facilities must be available for properly mixing the solution.

Figure 4 illustrates the pump circulation method. The overflow from the boiler is carried back to the pump location where it is collected in a suitable tank equipped with a drain going directly to the sewer. The pump suction should be so located that any solid materials carried over in the overflow will not be picked up by the pump to be circulated back through the boiler.

Solution Heated by Direct Firing

In extreme cases where no other source of heat is available, it may be necessary to obtain the proper temperature of the solution by direct firing of the boiler. This should be done only as a last resort and only when very careful control of the temperature can be maintained. In no case should a coal or wood fire be used, since accurate control of the flame cannot be maintained. An oil torch or gas burner is the only type of firing that should ever be used for this method.

At best this system is hazardous in that the maximum temperature allowed for the inhibitor may be easily exceeded because of local overheating of the metal before the true temperature of the solution throughout the unit can be obtained. In no case should the flame be allowed to come directly in contact with any of the metal surface. If this method is used, it is advisable to have thermocouples installed on the front generating tube bank. The temperature should be checked continually on the outside of these tubes and the flame must be controlled to prevent the temperature from exceeding the maximum limit set for the inhibitor being used.

While the above discussion refers mainly to the chemical cleaning of boilers, the chemicals and methods described are readily adapted to the cleaning of auxiliary equipment such as economizers and superheaters.

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How to Get Efficient Operation & Economy in Piping Systems

(Continued from page 83)

line. In larger steel lines a standard cast-iron sleeve is placed flush with the concrete wall, and the exposed pipe is calked therein. Cast-iron lines emerging from concrete are placed with the end of a bell flush with the face of the wall.

Pipes passing through walls and floors are sleeved, with sleeves in floors extending 1 in. above the floor to permit floor washing without water spilling to the room below. Black steel pipe is used for sleeves, except where rust action would prove objectionable, in which case galvanized sleeves are used. Piping systems are provided with drains at the low points to facilitate repairs and to drain water lines which are subject to freezing. A good designer always provides a closure piece in a piping system between two pieces of equipment where there are intervening flanged fittings or valves, instead of designing the system fitting to fitting. This is necessary because fittings and valves seldom are furnished to exact dimensions, and the closure piece takes up the inaccuracies in dimensions. Pipe lines are arranged to provide adequate access to machinery for inspection and repair, and to permit the removal of equipment without the necessity of dismantling large sections of piping. Figure 6 is a good example of this.

It is of prime importance in the design of a piping system to provide for the maximum ultimate requirements.

Analysis for Economy

Next in importance to functionalism in a piping system is that the design shall be economical. This factor involves the proper selection of the material, type, and size of the various pipe, valves, and equipment. It is compounded from a great many elements, some of the more important of which are (1) expected life versus cost, (2) higher pumping costs because of reduced sizes versus smaller initial investment, and (3) increased operating conveniences and reduced maintenance expense versus the added cost for obtaining these features. If these three points are carefully evaluated in the design of each system, it is fairly certain that an economical design will result.

From past experience and from technical data on the subject, the expected life of a pipe or valve may be closely estimated. Obviously, the longer life is more desirable, but it is necessary for the designer to balance the extra years of service against the added cost necessary to obtain it.

The size of each pipe line, once the maximum flow is established, is almost entirely a function of the pressure drop due to friction in the line. It is necessary to investigate each line for head loss, using the friction characteristics for the fluid carried. Sizes of equipment connections should never be construed as indicative of proper pipe size. In most cases the size of pipe mains for water systems is dictated by the flow necessary for fire protection. In evaluating pumping costs and pipe sizes, it must be remembered that station power is cheap in a hydro plant. On the other hand, most of the added cost of a larger size pipe is the material, itself, since the labor of installing each size line is practically the same. It is advisable not to have too many different sizes and kinds of pipe in a plant since this requires a larger stock of replacement parts for valves and specialties.

The amount of money that should be spent for operating conveniences and reduced maintenance is largely determined by experience and judgment. A good many operating conveniences may be had without extra cost if the systems are properly designed. Valves should be located so that their purpose is apparent at a glance, and they should be accessible, especially those required in an emergency, using chainwheels where necessary. There should be sufficient unions in screwed lines to facilitate disassembly. All waste and drain lines, especially those buried in concrete, should have cleanouts at strategic points. The practice of burying plumbing or other piping in walls should be avoided; it is much better to provide access corridors behind the fixtures for service and maintenance.

Hangers, Supports and Expansion Joints

In a well-designed piping system the weight of the pipe and its contents are always supported so that no stresses are transmitted to any of the valves or machinery. The stresses introduced in equipment in this manner, coupled with vibration, may eventually break the casting of a pump or valve. Standard commercial hangers are used where possible, as they are cheaper than designing special hangers for individual applications.

While the temperatures encountered in hydro-plant piping systems do not give rise to many expansion problems, the long lengths of the lines in a multiunit plant do call for some expansion design. The Authority uses pipe bends and offsets, where possible, in preference to guided slip joints with packing boxes. Sometimes, where vibration is coupled with expansion in a pipe line, a corrugated type of joint is used.

Painting

All piping systems of the Authority, including all insulation, are painted for appearance, protection, and identification, in accordance with a standard color code. Each system has its own color, and this standard is maintained throughout all the plants. The whole system is first painted with an aluminum paint, and identification is obtained by painting the periphery of flanges or by painting an occasional screwed elbow or tee, as the case may be, with the color of that particular system. If the length of line between these identification points is long, a narrow band is painted around the pipe at intervals. Arrows are sometimes painted on pipe lines where the direction of flow is not evident at a glance.

Fig. 5. Piping in oil-purification room in one of earlier plants

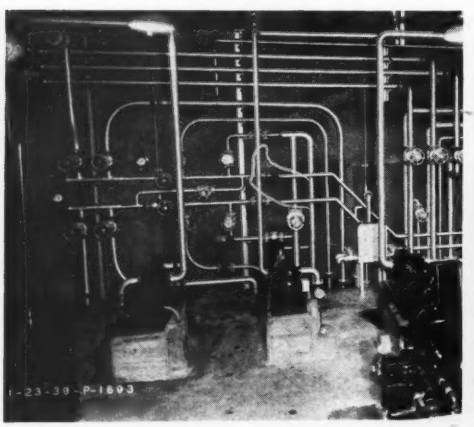
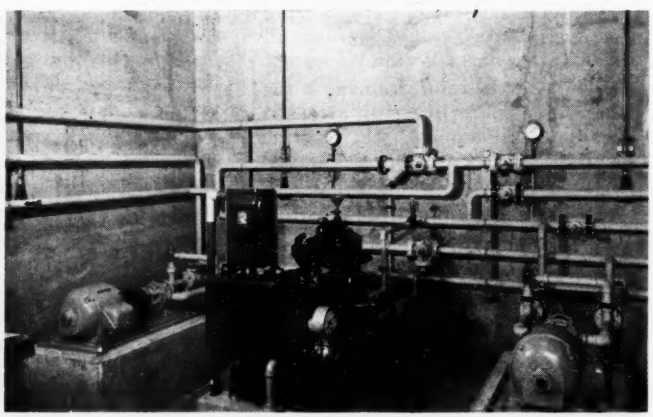


Fig. 6. Piping in oil-purification room in a later plant, showing methods used to improve system as compared with that of Fig. 5



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FUEL FLEXIBILITY

The spreader stoker will burn an extremely wide range of coals and coal sizes with little if any clinker formation, because of thin fuel bed and excellent air distribution. Ash fusion temperature has little effect on the performance of the stoker itself. Good combustion is obtained with hourly heat releases per square foot of grate area of 250,000 to 500,000 B.T.U. with stationary and dumping grates and this rate can be increased with continuous cleaning grates.

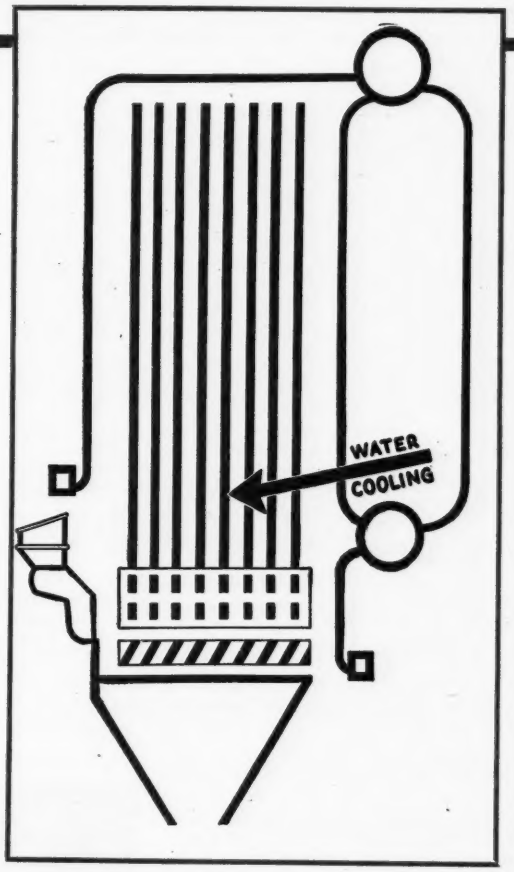
FURNACE DESIGN

The critical factor in spreader stoker installations is furnace design. Water cooling is essential except for small installations and for boilers operating at low ratings. Furnace arches, if used, should also be water cooled.

In good practice there is very little difference in furnace design for the various bituminous coals and sufficient volume to limit the heat release to a maximum of 35,000 B.T.U.'s per cubic foot per hour is ordinarily satisfactory.

Modern furnace design also gives smokeless combustion and fly ash is eliminated by including after separators.

The spreader stoker, water cooled furnace unit, properly designed, insures freedom from clinker, tube and wall slag. This combination affords a clean operating unit which will stay on the line for long periods of time at high efficiency and with low power and maintenance costs.



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ASME Meeting in Detroit

FROM JUNE 17 TO 20, the American Society of Mechanical Engineers held its semi-annual meeting in Detroit, Michigan, with the Engineering Institute of Canada participating. Although the usual routine of society business and committee work kept many of those in attendance busy, the technical sessions were well patronized and the discussion of developments in the field indicated healthy progress is being made in the application to peace-time purposes of principles developed for war-time production. War secrets, with the exception of those associated with the atomic bomb, are now being revealed, and industry may look forward to the use of many important developments in materials and processes that came about during the war.

Two sessions were devoted to power and two to fuels with papers and discussions of special interest to engineers in the power plant field. Other sessions on oil and gas power, the gas turbine, heat transfer metals and other materials, fluid meters, automotive engineering and aviation were productive of many new ideas of interest pricipally to specialized industries. More general were sessions on management, product engineering, machine design, process industries, education and training, materials handling and the address at the various luncheons, dinners and the banquet.

As customary the nominating committee conducted hearings and reported the following as nominees for office in 1947, the election to be held by letter ballot of the entire ASME membership before September 24.

For president: Eugene W. O'Brien, vice president of the W. R. C. Smith Publishing Co., Atlanta, Ga. Mr. O'Brien was graduated from Brown University in 1919 with the degree of B.Sc in EE, received the SC.M. in 1921 from Brown and in 1924 was awarded an ME degree from Yale. He was a member of the engineering faculty at Brown in 1922 and later at Sheffield Scientific School. He left Sheffield to join the engineering firm of Jenks and Ballou which position he left in 1927 to become editor of Southern Power Journal.

For regional vice presidents: Alton C. Chick, Manufacturers Mutual Fire Insurance Co., Providence, R. I.; A. R. Mumford, Combustion Engineering Co., New York City; E. E. Williams, Duke Power Co., Charlotte, N. C.; T. S. McEwan, McClure, Hadden and Ortman, Inc., Chicago, Ill.; and Linn Helander, Kansas State College, Manhattan, Kan.

For directors: F. S. Blockall, Jr., Taft-Pierce Mfg. Co., Woonsocket, R. I.; B. V. E. Nordberg, Nordberg Mfg. Co., Milwaukee, Wis.; L. F. Moody, Princeton University, Princeton, N. J.; and W. A. Carter, Detroit Edison Co., Detroit, Mich.

Atomic Power

Foremost among the topics of discussion was the use of atomic power for civilian purposes. Speaking on "The Navy's Interest in Nuclear Energy for Power Use," Rear Admiral Bowen said:

"In case of another world conflict our chief hope of survival would be that industry be placed on an atomic-power basis just as rapidly as possible. The Navy's vigorous pursuance of atomic power will contribute materially to this conversion in industry.

"Under the Civilian Atomic Energy Commission, consistent with any international arrangements, and within the sphere of naval uses, the Navy hopes to take the lead in the development of atomic power. To do otherwise would be to neglect our duty grossly and to fail in discharging our responsibilities to our country. This development of power should proceed as rapidly as possible."

"The widespread utilization of nuclear energy for peaceful industrial purposes is inevitable," Senator Brien McMahon, (D. Conn.) Chairman of the Senate Special Committee on Atomic Energy, told his audience. "The question is, shall it come about in an orderly and evolutionary manner, one which will substitute new industries as the old ones become obsolete, one which will provide new jobs as the old ones are done with? Or shall it come about in an uncontrolled chaotic and revolutionary manner?

"The intent of the McMahon Bill is not to restrict or retard development or utilization; its purpose is to bring about development and utilization, to give the people who invested billions of dollars in this project the dividends on their investment, but to do it in a manner which will make it a blessing rather than a curse because of needless suffering and misery. The unlocking of the atom was a revolution. There can be no dispute about that. Now we must do something new in human history. We must police a revolution for the protection of the people."

A. L. Baker of the Kellex Corp., New York, was another speaker. Alex D. Bailey, of Chicago, chairman of a committee of the ASME on nuclear energy, presided at this session of the meeting.

At the banquet, General Jacob L. Devers was the principal speaker and chose as his subject America's Security. He named the following five essentials to its attainment: First, Americans must "put their own house in order," practice teamwork, cease to regard America as "an inexhaustible wishing well" where good things come without effort.

Second, this country must clarify its course of action in international affairs.

Third, it must learn to understand other nations, "Suspicion and recriminations" between the United States and Russia are due to such lack of understanding, General Devers said. Facts are essential to understanding, he said, and he urged "an intelligence system second to none."

Fourth, America must work for some form of world co-operation or government.

Fifth, the armed forces must be maintained "at a level of strength and efficiency at which they can perform any mission they may be given."

Another feature of the banquet was

President Yarnall presenting certificate of honorary membership to William S. Knudson in the presence of J. W. Parker who read the citation

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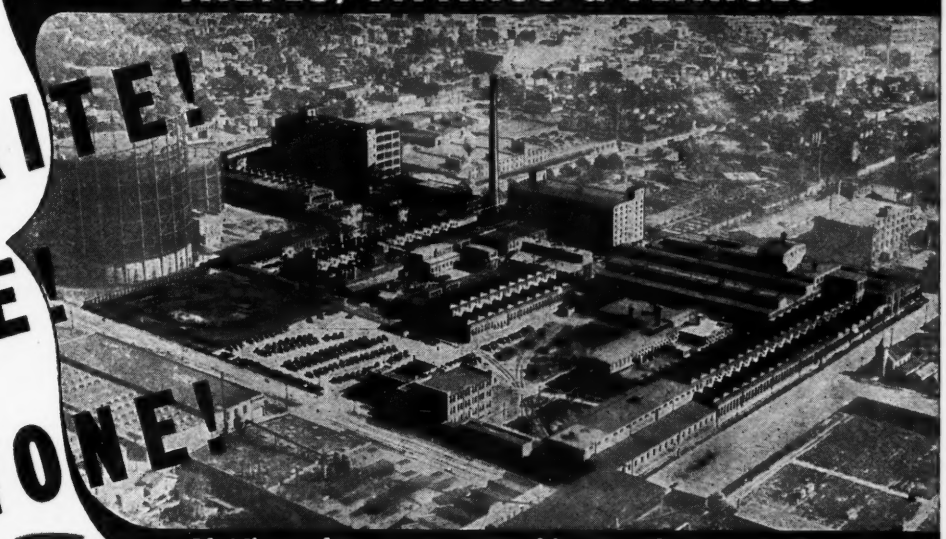

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the presentation of Honorary Membership in the ASME to General Knudson by Dr. D. Robert Yarnall, president of the Society, in recognition of his preeminent accomplishments in production.

Power Sessions

Sessions devoted to power are always popular at ASME meetings and with four such excellent papers as were presented at the two sessions the interest was intense and the discussion active. The papers with short summaries are given in the accompanying listing. Mr. Smith's paper on automatic air soot blowers cleared up many doubts in the minds of operators regarding the practicability of this rather new system, which is now being used in but a few large and important boilers.

Likewise the application of spreader stokers to large boilers has not heretofore been too numerous and engineers were given the report of Mr. Drabelle on his success in burning midwest coal on one of the largest units of this type.

The practice of cleaning boilers with acid is old in principle but the success of its application has had to wait for chemists to develop solvents and methods that will assure thorough cleaning without danger of corrosion to boiler metal, as was explained by Mr. Powell.

In the development of our hydroelectric resources, engineers have found it necessary to build steam plants as standby stations to be started quickly in case power service from the hydraulic plant should be interrupted for cause. Such plants are subjected to unusual conditions of fluctuating loads and it was to those problems that Mr. Kuhner directed the attention of his audience.

Oil and Gas Power

E. M. Fernald discussed gas-turbine patents, S. A. Tucker, European gas-turbine developments, P. R. Sidler, recent Brown Boveri developments, John Drake, power booster system for propeller drive gas turbines, A. J. Nerad, combustion and ignition in aircraft gas turbines, A. D. Hughes, the design and operation of some experimental high temperature gas turbine units, Norman L. Mochel, the metallurgical consideration of gas turbines, and F. Salzmann the regulation for thermal power plants employing a closed cycle gas turbine.

Papers of Particular Importance to Power Plant Engineers Presented at the Semi-Annual Meeting of the A.S.M.E.

Burning Low Grade Midwestern Coals on Spreader Stokers with Continuous Ash Discharge at the Iowa Falls, Iowa Generating Station of Central States Electric Co.—By John Drabelle

The use of a spreader stoker with continuous ash discharge for firing a Combustion boiler rated at 125,000 lb per hour, 420 psig-750 F, at superheater outlet—in the Central States Electric Co.'s power station at Iowa Falls, Iowa, was described. Complete design data as to the furnace, water walls, the covection section of the boiler, superheater, air heater, forced and induced draft fans, cinder return system, overfired air system, combustion control and the stoker were given. The characteristics of the coals of Northern Illinois and Iowa fields were given, together with the operating results obtained; experiences of this public utility company in the operation of the unit were included, together with comments of other operators of similar equipment in central station service. A statement as to the conditions found in the furnace, convection section of the boiler, superheater, air preheater, precipitator unit, fans and stoker was included. The inspection condition covers 6000 hr of operation of the unit.

Remarks on the Regulation Theory for Thermal Power Plants Employing a Closed Gas Cycle.—By F. Salzmann

This paper dealt with the power regulation of gas turbine plants employing a closed cycle according to the proposals of Ackeret and Keller. Theoretical calculations were shown in order to follow the non-stationary processes, which occur in the plant when changing load. It was demonstrated how the regulation means shall operate with respect to the specific properties of the closed cycle for ensuring a quick action in the case of sudden load changes.

Acid-Cleaning of Boilers and Auxiliary Equipment.—By S. T. Powell

Acid-cleaning of equipment, Mr. Powell stated, has been demonstrated over a long period as a useful and economical means for removing encrustations from boilers and many other types of power-plant equipment. His paper explained the use of various cleaning reagents and inhibitors, the procedure which should be followed, and the precautions to be taken to safeguard both personnel and equipment from the hazards inherent in the process.

Lubrication Problems of Internal Combustion Engines—Today.—By J. Musser Miller

The author described the development of additive oils—commonly defined as heavy duty motor oils—which contain among other ingredients, metallic soaps to reduce piston deposits. Tests and experiences with additive oils for military and naval uses were cited, the action of inhibitors to neutralize acidic bodies was described, and the use of additive oils for Diesel engines in civilian service was discussed.

Boiler Design for Extreme Load Variations. —By M. H. Kuhner

In this paper the author summarized the required design provisions for boilers adapted to operate under quick demand changes. Reference was made to the quick pick-up boiler in the Harbor Steam Plant of the City of Los Angeles and the steel-mill boiler at the Homestead Works of the Carnegie-Illinois Steel Corp. The importance of water storage, unrestricted path for water and steam in circulation, steam release with minimum disturbance of water body in drum, steam-temperature control during unbalanced firing, and the effect of each item on the others, was discussed. Recommendations were made for determining required capacity of fuel-burning equipment and fans in reference to the extent and rapidity of steam-load changes.

Experiences with Automatic Air Soot Blowers at the Oswego and Charles H. Huntley Steam Stations.—By H. L. Smith

The author related in some detail the experience obtained with full automatic air soot-blowing equipment installed as the cleaning equipment for the external surfaces of three large pulverized-fuel-fired steam generators. A brief description was given of the blowing equipment, compressors, and automatic controls; information of general interest as to the actual operating performance; and the relative installed cost and investment, as compared to comparable steam equipment.

Coal Handling at Philo

(Continued from page 81)

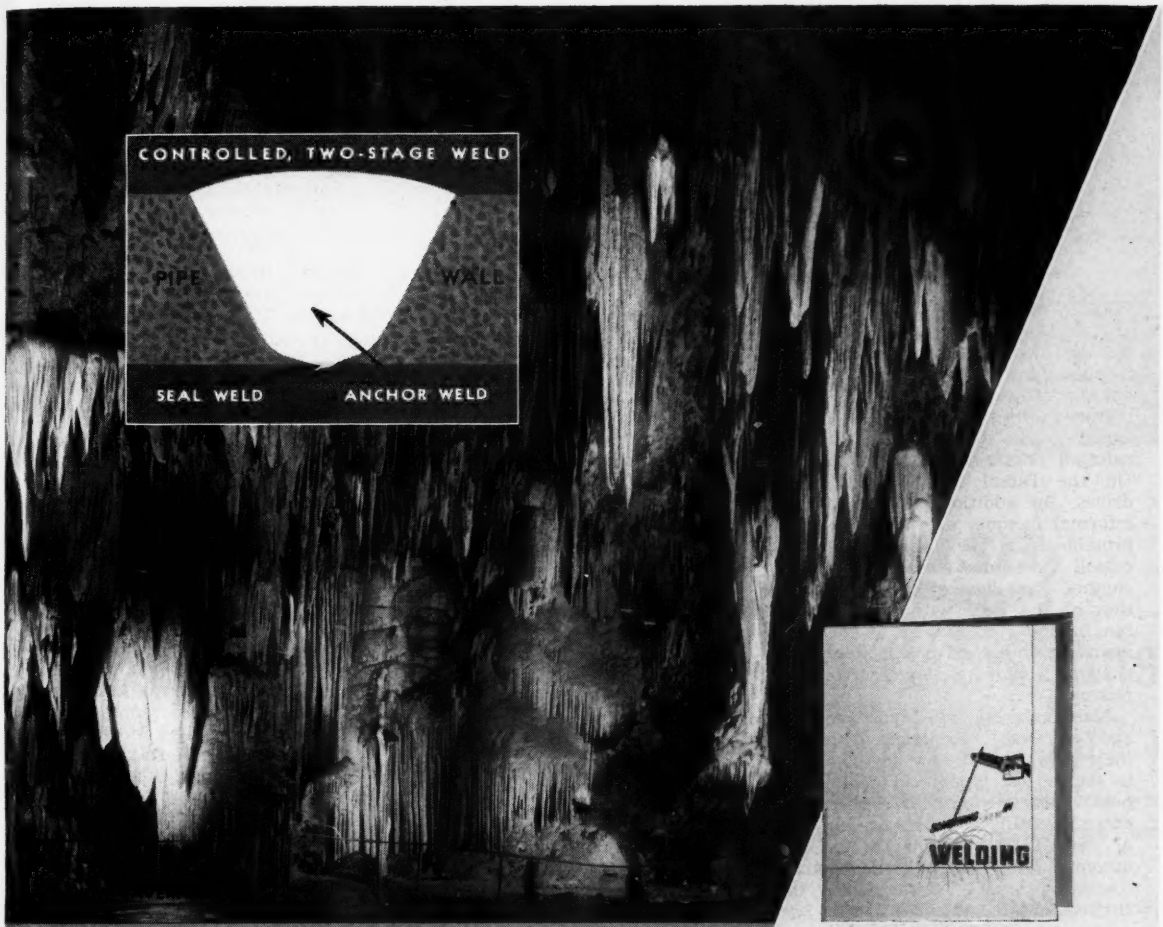
ment which would have required the building of another room.

Reconstruction of the Control Panels

As a preliminary to the installation of the new equipment, it was decided to re-wire the panels so that all the superfluous contactors could be taken out of service. It was no longer necessary to have interlock relays, undervoltage relays, current limit relays and accelerating contactors. In making the changes to the new system of control, it was of course, necessary to keep all of the equipment in service practically all of the time, since the plant requirements did not permit shut-down of the coal handling motors for more than a few hours at a time. In fact, most of the changes were made while the 440 volt equipment was alive. The effect of each move had to be analyzed carefully so as to be sure that it would not interfere with normal operation, and once a change was started it had to proceed as rapidly as possible since two different schemes of control were performing overlapping functions. Over 150 separate moves were required for changes in the control circuits alone.

Figure 5 is a photograph of the control equipment that remained in service after these changes were made. All motors continued to operate as before and no sacrifice was made in connection with any control or by-pass facilities. This photograph should be compared with Fig. 1 to appreciate how much equipment was removed.

(Part II will describe how the control system was completely converted from that of Fig. 5 to that of Fig. 4.)



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Diesel Engineers Convene at

Oil and Gas Power Conference

Breakdown of the 5,000,000 to 6,000,000 hp of stationary Diesels into specific industries . . . Diesel generator in 30,000 kw steam plant . . . More utilization of Diesel exhaust heat called for . . . Swiss company building commercial gas turbine power plants

THE 18TH NATIONAL Oil and Gas Power Conference, sponsored by the ASME, was held June 12 through June 15 at the Hotel Schroeder in Milwaukee. The conference featured informative panels on Diesel engines, gas turbines, gas Diesels, railroad engines, new developments (in the Diesel field) and marine drives. In addition, it included an informal banquet at which five men prominent in the Diesel field discussed the future outlook for Diesel engines, each speaker covering a portion of the field with which he is familiar; the breakdown of the field including ships and boats, stationary usage, oil industry, automotive and railroad.

Manufacturers of Diesel engines and auxiliary equipment displayed their products and new developments in the largest equipment exhibit yet held in connection with the conference. The Allis-Chalmers scale model of their 10,000 kw gas turbine and accompanying schematic diagram attracted a lot of interest from the engineers.

Inspection trips to various Milwaukee plants were provided on Thursday and Friday afternoon, Thursday's itinerary including the Diesel Shops at Nordberg Mfg. Co., and Friday's offering a choice of the Ladish Drop Forge Co., Falk Corp., or the Pabst Brewery.

Gas Turbine

Two panels were devoted to discussion of gas turbines, and papers were presented by A. D. Hughes of Allis-Chalmers, Professor E. M. Fernald of Lafayette College, S. A. Tucker of McGraw-Hill World News, P. R. Sidler of Brown-Boveri, and F. Salzmann of Escher Wyss.

To many engineers who had heretofore regarded the practical application of the gas turbine to power plants as something in the far distant future, Mr. Sidler's announcement that his company has several contracts for gas turbine power plants, some already completed and under test at the factory before final delivery, came as a rather startling revelation.

Mr. Tucker pointed out that this is a good indication that the gas turbine power plant is ready for commercial use, since the Swiss are noted for their thoroughness and hesitancy to make any claims or accept contracts until they are positive of the commercial feasibility of their products.

Diesels in Steam Plants

A. C. Kirkwood,* Burns and McDonnell Engineering Co., presented a study of the merits of installing a Diesel generator in a 30,000 kw steam plant to level the peaks and valleys of the daily load curve. Because of the individuality of his study, the value of the paper was not so much in the data themselves, as in the method used to conduct the study. Mr. Kirkwood puts it this way: "All inclusive conclusions are not permissible except to the extent that these data illuminate a possible pathway."

Stationary Diesel Engines

In his paper, (presented in his absence by O. O. Lewis) "Diesel Engines in Stationary Usage," R. H. Morse, Jr., Fairbanks-Morse & Co., gave an estimate of the total horsepower of Diesels in stationary use and a breakdown of this figure into specific industries. He said, "It is estimated that there are today between 5,000,000 and 6,000,000 hp of stationary Diesel engines in use in the United States, and this figure does not include the engines which were supplied to meet the requirements of the armed forces. Seventy-two per cent of this 5,000,000 or 6,000,000 hp is distributed as follows: municipal power plants are using 27 per cent; private utilities and REA co-operatives take 14 per cent; 12 per cent is on the oil pipe lines and otherwise working for the oil industry; cotton gins and oil mills account for 8 per cent; the grain industry is using 6 per cent; the remaining 5 of the accountable 72 per cent is at work making ice and providing other refrigeration. The miscellaneous unclassified 28 per cent is scattered through industries such as mining, rock and clay products, textile mills, lumber and woodworking, irrigation, metal working, and others."

Pointing out that more attention should be directed towards the utilization of engine exhaust heat, Mr. Morse continued, "The possibilities for waste heat recovery and utilization are just beginning to be appreciated, and for all our smug boasts of the efficiency of our product (Diesel engines), we should not forget that we throw away more than 60 Btu for every 40 that we convert into motive power. Better engineering and more research will expand the applications of heat recovery, and widen the Diesel's field of profitable application."

*An abstract of Mr. Kirkwood's paper will appear in a later issue of POWER PLANT ENGINEERING.

Following is a complete list of the papers presented at the Oil and Gas Power Conference:

PROGRESS REPORT ON DIESEL DEVELOPMENTS—1936 TO 1946, by Prof. Robert R. Rice, University of North Carolina.

DIESEL ENGINES IN STEAM PLANTS, by A. C. Kirkwood, Burns and McDonnell Engineering Co.

FUTURE OUTLOOK FOR DIESEL ENGINES. IN SHIPS AND BOATS, by R. E. Friend, Nordberg Mfg. Co.

IN STATIONARY USAGE, by R. H. Morse, Jr., Fairbanks, Morse & Co.

IN THE OIL INDUSTRY, by A. W. McKinney, The National Supply Co.

ON WHEELS, by V. C. Genn, General Motors Corp.

ON RAILROADS, by L. W. Metzger, Baldwin Locomotive Works.

SYMPOSIUM ON DIESEL ENGINES FOR RAILROAD SERVICE—reports by J. H. Davis, Fairbanks, Morse & Co., Ralph Miller, Nordberg Mfg. Co., Hans Bohuslav, Sterling Engine Co., and Ralph Boyer, The Cooper-Bessemer Corp.

SYMPOSIUM ON GAS-DIESEL DEVELOPMENT—reports by Ralph Boyer, The Cooper-Bessemer Corp., Ralph Miller, Nordberg Mfg. Co., C. E. Cox, Chicago Pneumatic Tool Co., J. C. Barnaby, Worthington Pump and Machinery Corp.

DESIGN AND OPERATION OF SOME EXPERIMENTAL HIGH-TEMPERATURE GAS-TURBINE UNITS, by A. D. Hughes, Allis-Chalmers Mfg. Co.

AN EXPLORATORY EXCURSION INTO PATENTS CONCERNING GAS-TURBINES, by Prof. E. M. Fernald, Lafayette College.

A NEW SYSTEM OF SUPERCHARGING, by Ralph Miller, Nordberg Mfg. Co.

DIESEL COMBUSTION TEMPERATURES—THE INFLUENCE OF OPERATING VARIABLES, by O. A. Uyehara, P. S. Myers, K. M. Watson, and L. A. Wilson, University of Wisconsin.

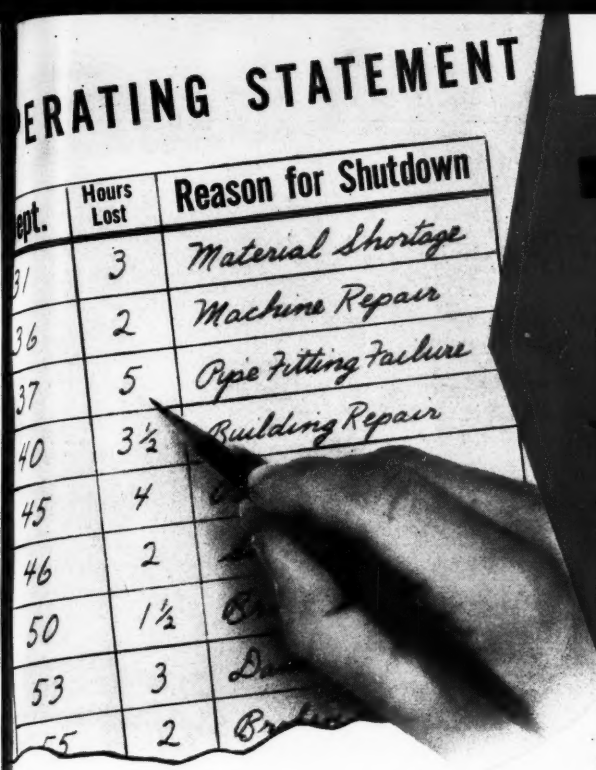
EUROPEAN GAS-TURBINE PROGRESS, by S. A. Tucker, McGraw-Hill World News.

RECENT GAS-TURBINE DEVELOPMENTS AT BROWN-BOVERI, by P. R. Sidler, Brown-Boveri Corp.

REMARKS ON THE REGULATION THEORY FOR THERMAL POWER PLANTS EMPLOYING A CLOSED GAS CYCLE, by F. Salzmann, Escher Wyss Engineering Works.

THE BOWES DRIVE, by W. P. Schmitter, Falk Corp.

HEAVY-DUTY CHAIN DRIVES FOR MARINE-PROPULSION SERVICE, by Norman Bremer, Morse Chain Co.



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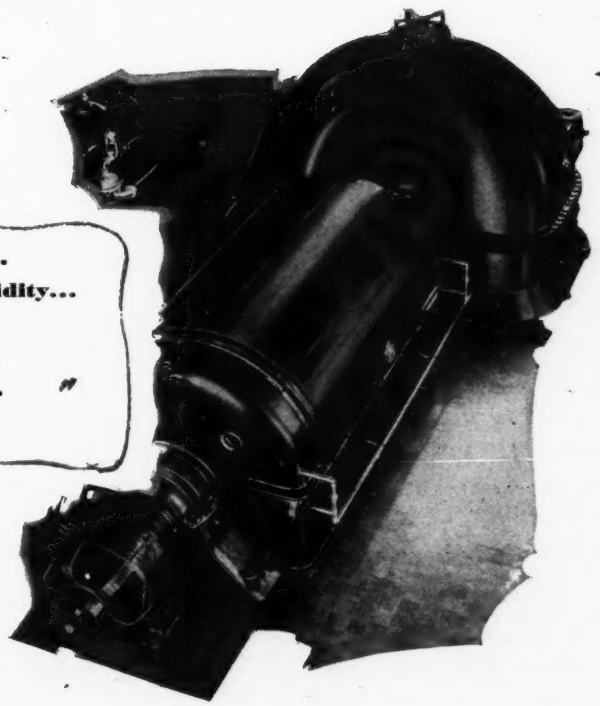

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Betz Handbook of Industrial Water Conditioning, prepared by the Chemical Engineering Staff of W. H. & L. D. Betz. Published in 1945; 171 pages; 8¼ by 10¾ in.; paper cover; published by W. H. & L. D. Betz, Gillingham and Worth Streets, Philadelphia 24, Pa. Price $1.00.

In this very interesting book the publisher has presented a large number of articles designed for the study, reading and reference of engineers interested in industrial water conditioning in all of its phases. The book contains 54 chapters and is divided into two sections. The first section entitled, "Water Treatment" contains detailed discussions of the chemical and mechanical processes available for treatment of water for industrial use, covering such subjects as coagulation, filtration, lime-soda softening, anion exchange, silica removal, boiler scale formation, embrittlement, slime and algae control. The second section entitled "Water Analyses" deals with the impurities in water, how they originate, how they can be removed and methods of analyses suitable for plant control. The entire chemical engineering staff of the Betz organization has contributed to the preparation of the book which will prove of great value not only to the engineer and chemist directly but to those whose work with water is of a more indirect nature. In the preparation of this handbook the authors made an effort to keep the text as understandable as possible to those who have only a limited knowledge of chemistry, and for that reason any man interested will find this handbook extremely valuable to him in the application of water treatment.

Practical Design for Arc Welding, by Robert E. Kinkead. Copyright 1945; 8½ by 11 in.; 200 pages; hard cloth binding; published by The Hobart Brothers Co., Troy, Ohio. Price $3.50.

This is the third and final volume of a three volume set by the author in which he gives idea stimulators for the arc welder. In this volume the author has developed three different lines of thought that will be of particular interest to welding designers and fabricators. Twenty design plates show in graphic form valuable hints on what not to do in designing for arc welding. These plates show common faults in design with suggestions as to how they may be avoided. In another twenty plates, are suggested the natural origin of many complex, modern design principles, and in the final twenty plates are shown typical patents that have been granted in connection with the welding process. The author states that the main object in preparing the "Practical Design for Arc Welding" Sheets is to give the designer and others a wealth of material to inspire newer and better designs for their own individual needs. The job illustrations have all been built so that there is nothing theoretical about them. The book starts with arc and gas welding symbols which have been adopted by the trade and gives an excellent illustration of typical welded joints, sections and symbols. There is included also a complete index of the various types of joints and plates which illustrate them.

Throughout, the entire book is most conveniently arranged for the designer with a plate opposite a page of co-ordinate lines on which the designer can make his sketches and with suggested data to be filled in before work starts on the project.

Lessons in Arc Welding, second edition, seventh printing. Copyright 1945; 5½ by 8½ in.; 176 pages; semi-flexible simulated leather binding; published by the Lincoln Electric Co., Cleveland 1, Ohio. Price 50 cents per copy in United States, 75 cents elsewhere.

The series of lessons published in this book are based upon the experiences of Arthur Madson, Instructor in the Lincoln Arc Welding School. The book starts with descriptions of several types of Lincoln arc welders and then takes up such simple operations as striking an arc and running flat bead, running continuous beads, weaving, padding, etc. and on down to lap welds, tee or fillet welds, butt welds, vertical welding, overhead welding, cutting with electric arc, welding with various types of electrodes and then takes up the principles of arc weld surfacing, and devotes several chapters on hard-surfacing. There are in all 61 lessons all clearly illustrated and instructions are given in complete detail. This book will be found extremely useful to the man who is desirous of learning how to use the welding outfit to better advantage.

Ball and Roller Bearing Engineering, by Arvid Palmgren, translated by Gunnar Palmgren and Bryce Ruley. Copyright 1945; 270 pages; 7 by 10 in.; cloth board binding; published by S. K. F. Industries, Inc., Philadelphia, Pa. First copies being sent by S. K. F. to heads of technical schools and colleges and libraries in principal U. S. cities. Later editions will be sold at cost by the company to students and others interested in bearing studies.

This book is intended to give an orientation in the field of ball bearing engineering by placing before the machine designer the fundamental principles upon which ball and roller bearings are built. The author recognizes that standardization of bearings has made the assignment of their design and manufacture to specialists. Thus the machine designer is not required to include in his efforts the working out of fundamental bearing problems. The original manuscript for this book was written in the Swedish language and the translaters decided to retain the metric system in this translation since most of the bearings discussed in the book are internationally standardized in millimeters. The chapter headings are: Common Bearing Types; Forces and Motions in Bearings; The Carrying Capacity of Ball and Roller Bearings; Bearing Selection; Design of Bearing Applications; Mounting and Dismounting; Lubrication and Maintenance; Bearing Failures; Tables; Conversion Values, Symbols and Abbreviations and a complete index. The man in charge of machinery using ball and roller bearings will find in this book points of interest and information which will assist him to get better efficiency and longer life out of his bearings.

A Bibliography on Cutting of Metals, prepared by Orlan W. Boston; published in 1945 by The American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y. 5½ by 8½ in.; 547 pages; simulated leather binding. Price $6.50.

The immense task of collecting references on the subject of cutting of metals was started by the author in 1919 and was continued at various times up to the present date when listed in this bibliography. There are some 5600 articles giving an extremely complete listing of articles on this important subject of metal cutting which would be of great aid to those in industry studying problems of this industrial art. The publication of this volume comes as a result of work done by the ASME Special Research Committee on Metal Cutting Data and Bibliography which received approval of its recommendation for publication in 1943. In the introductory chapter it is stated that the metal cutting era may be divided into periods, namely, the age of carbon tool steel up to 1894, the age of self-hardening steel from 1894 to 1900 and from 1900 to the present as the age of high-speed steels. The last few years have been an era of additional materials for metal-cutting tools such as the diamond, Stellite (since 1915) and the sintered tungsten-, tantalum-, titanium- (or combined-) carbides, since 1928. The book covers all recognized authoritative articles published in the technical literature since 1864, in foreign languages as well as English. The bibliography is arranged in chronological order but there is a complete author's index, taking up one section of the book. Other information included are tables on various phases of the cutting processes.

Fluid Flow in Piping, by J. M. Dalla Valle. Copyright 1945; 29 pages; 8½ by 11 in.; paper bound; saddle stitched; published by Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $1.00.

This monogram is prepared as a simple and concise summary of the fundamentals of fluid flow theory and practice, with applications of these basic data to practical problems of steam, water and air piping. The pamphlet is divided into two sections. The first taking up the fundamentals of fluid flow and the second giving applications of fluid flow theory. The objective in preparing this monograph is to stress the basic background of the general problem itself. Portions of the theoretical treatment are new for the sake of simplicity the mathematical portions are restricted as much as practicable. This somewhat limits the comprehensiveness but only insofar as the more advanced phases of the subject are concerned. The reader will find many ideas here which will help him in the design of his piping and will find a number of problems worked out specifically which will form a pattern for the solution of his own piping problems.

A Little Water is a *Dangerous* thing

Remove It- with a DE LAVAL

IN the lubricating system of a turbine or a Diesel engine, water can be a serious trouble-maker. It is every bit as necessary to remove moisture as it is to keep the lubricating oil free of dirt.

De Laval Oil Purifiers accomplish this dual function perfectly. By means of centrifugal force, they continuously discharge from dirty oil not only any solid impurities that may be present, such as rust, scale or dirt, but also any condensate or other moisture—whether only a few drops or several quarts per reservoir of oil.

Water in turbine oil leads to sludge, and sludge to serious deterioration of the oil. Water in Diesel oil forms an emulsion with the oil which may eventually lead to practically no lubrication at all. This is of especial importance on installations where the new heavy types of Diesel lubricating oil are used.

In short, De Laval Oil Purifiers are trouble-preventers. They afford more reliable protection to power units because their action is continuous, efficient and economical.

Write for additional details. Mention what type of power unit you have.

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LUBRICATING OIL PURIFIERS

MANUFACTURERS' News

G.E. Views Atomic Research

COMMENTING on the War Department's announcement of a contract with the General Electric Co. for atomic energy research and development and the transfer of operations of the Government-owned plant at Hanford, Wash., to the General Electric Co., Charles E. Wilson, president of General Electric, said recently:

"The Company was engaged in atomic research for peacetime application before the war. With this background we are convinced that the quickest possible development of non-military applications not only is the most constructive solution to the problem which atomic energy presents to the world, but our greatest opportunity for more jobs and more goods for more people in the future.

"In our Research Laboratory in Schenectady we have already intensified the research, which we began before the war, in fields relating to atomic energy. The Hanford Works is an essential part of any over-all program of continuing research and development in atomic power."

The Hanford Works will be operated by a manager with an advisory committee consisting of H. A. Winne, vice president in charge of engineering policy; Dr. C. G. Suits, vice president and director of the G.E. Research Laboratory, and Dr. Zay Jeffries, vice president and general manager of the G.E. Chemical Department.

Perfex Opens Branch Offices

The Perfex Corp., Milwaukee, on May 15 opened branch offices at Cleveland and Detroit.

In charge of the Cleveland branch, located at 2010 E. 102nd St., is Charles M. Campbell who joined Perfex in 1944 as Sales Engineer. Mr. Campbell is a graduate of Purdue University '35, and prior to coming to Perfex spent 10 years in sales work.

The Detroit office at 9545 Grand River Avenue is under the supervision of S. David Horner. Mr. Horner spent three and one-half years in the navy, and received his honorable discharge as Lieutenant Commander just prior to joining Perfex in January, 1946, as Sales Engineer. Prior to his military service, Mr. Horner was associated with the Powers Regulator Co., Chicago, and the Carrier Corp., Syracuse, N. Y.

Texaco Completes New "Cat Cracker"

COMPLETION of a new multi-million dollar fluid catalytic cracking unit for Texaco's Lockport, Ill., refinery was announced recently. This unit, equipped with the largest fractionating tower ever used on a "cat cracker," enables the refiner to squeeze, on an average, an additional two gallons of gasoline out of every barrel of crude oil.

Designed to process high octane gasoline components for aircraft, the unit is now turning out 13,000 barrels per day of the same materials for high octane automotive fuels. It is predicted that at year's end output of this latest unit will be pushed up to 20,000 barrels per day.

The unit operates on a 24 hour a day schedule and will be shut down only once a year for a brief inspection period. It has a height of a 12 story building and requires the full time of 52 men solely for operating purposes. This is the most compact unit yet designed, incorporating improvements born out of wartime experience with this all-important refining process.

Stone to Manage G.E. Coshocton Plant

APPOINTMENT of Guy M. Stone as manager of the Coshocton, Ohio, plant of the General Electric plastics divisions was announced recently. The Coshocton factory, to be used for the manufacture of laminated plastics, is now under construction.

Mr. Stone is now serving as manager of the Lynn Works of the G-E plastics divisions from where the laminating manufacturing operations are soon to be transferred. He has held this position since 1939. Mr. Stone has been associated with General Electric for 30 years in Schenectady, Baltimore, Philadelphia, Meriden and Pittsfield.

National Tube Buys New Facilities

NATIONAL TUBE CO., United States Steel subsidiary, recently announced the purchase from Reconstruction Finance Corp. of a portion of the facilities acquired and installed for the government during the war by the Tubular Alloy Steel Corporation in its Gary plant.

The purchase price was $4,775,000 and the purchase covered facilities adaptable for production of peacetime products with the balance to be removed from the plant by Reconstruction Finance Corporation. The original cost of all the facilities installed for the government was approximately $12,282,000.

Jarvis Co. New Warren Pump Agents

WARREN STEAM PUMP CO., INC., Warren, Mass., announces the appointment as district agents of Jarvis Equipment Co., 795 East McMillan street, Cincinnati, Ohio. It will represent Warren Pumps, centrifugal and reciprocating types, in the state of Kentucky, and in the southern sections of Ohio, Indiana and West Virginia.

COMING EVENTS

National Assn. of Power Engineers—National Power Show; to be held in Cleveland at the Cleveland Public Auditorium, August 19 to 22, inclusive.

National Assn. of Power Engineers—Annual convention of the NAPE; to be held in Cleveland at the Public Auditorium, August 19 to 22, inclusive.

American Chemical Society—National Chemical Exposition, sponsored by the Chicago Section of the Society; to be held September 10 to 14, in the Chicago Coliseum.

National Chemical Exposition—Biennial Exposition, sponsored by Chicago Section of American Chemical Society; to be held September 10 to 14 in Chicago Coliseum.

Instrument Society of America—"Instrumentation for Tomorrow" exhibit; to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

American Society of Mechanical Engineers—Instruments and Regulators Committee; meeting to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

National Electronic Conference—Conference sponsored by Illinois Institute of Technology, Northwestern University and the Chicago Sections of AIEE and IRE; to be held at the Edgewater Beach Hotel in Chicago, October 3 to 5.

American Welding Society—1946 annual meeting to be held in New York City, October 24; headquarters not yet announced.

Seventh Annual Water Conference—Sponsored by the Engineers Society of Western Pennsylvania; to be held in Pittsburgh October 28 to 30, with headquarters at the Hotel William Penn.

Refrigeration, Air Conditioning Show—Sponsored by Refrigeration Equipment Manufacturers Assn.; to be held in Cleveland, October 29 to November 1, in the Public Auditorium.

American Welding Society—1946 annual meeting (reassembly) to be held in Atlantic City, November 17 to 22; headquarters at Municipal Auditorium.

National Metal Congress and Exposition—To be held in Atlantic City, November 17 to 22, headquarters at Municipal Auditorium.

Power Show—17th National Exposition of Power and Mechanical Engineering; to be held in New York City, at the Grand Central Palace, December 2 to 7.

ASME—American Society of Mechanical Engineers; mid-winter meeting, to be held December 2 to 7.

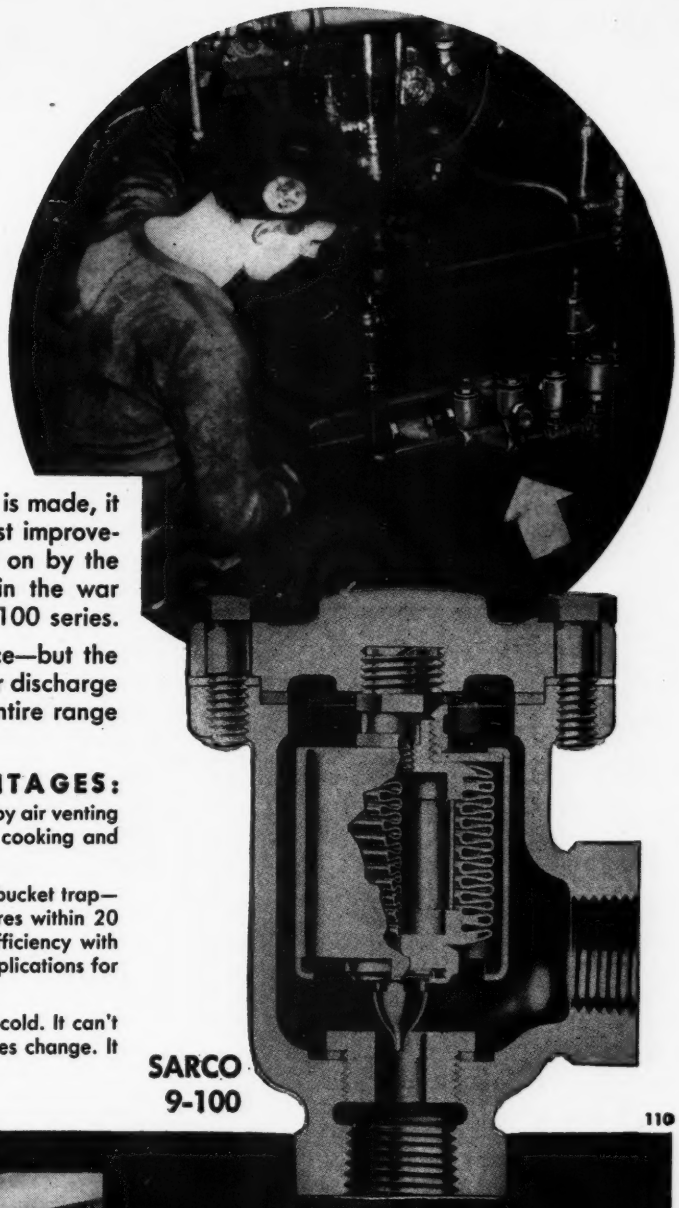
Heating and Ventilating Exposition—7th International Heating and Ventilating Exposition; to be held January 27 to 31 in Cleveland at Lakeside Hall.

Electrical Engineering Exposition—Annual show (Postponed since 1941) to be held in New York City, January 27 to 31; headquarters at 71st Regiment Armory, Park Ave. and 34th St.

AIEE—American Institute of Electrical Engineers; winter convention to be held January 27 to 31.

NOW TWICE AS GOOD—

THE NEW SARCO THERMOSTATIC STEAM TRAP



Whenever a better thermostatic steam trap is made, it will still be called "Sarco No. 9." The latest improvement, after years of development spurred on by the tremendously expanded use of this trap in the war effort, is now ready for you in the new 9-100 series.

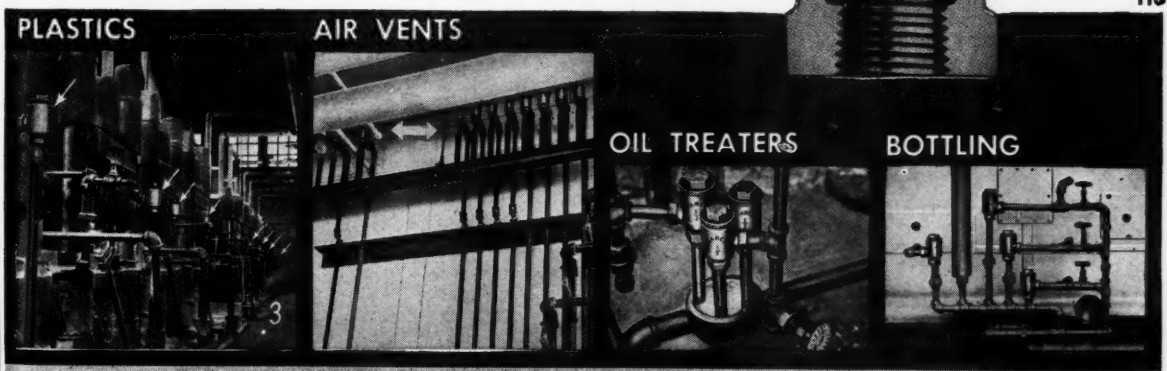
No larger—not much change in appearance—but the valve orifices are larger and the capacity for discharge of *condensate* or *air* is doubled over the entire range of sizes.

HERE ARE SOME OF THE ADVANTAGES:

1. In process work, cooking time is governed more by air venting than trap capacity or speed. Actual output of cooking and similar equipment will be greatly increased.
2. The new No. 9 will operate almost as fast as a bucket trap—but have full capacity at condensate temperatures within 20 degrees of the steam. It is thermostatic trap efficiency with bucket trap capacities—a whole new field of applications for the No. 9.
3. Like other No. 9's, this trap is wide open when cold. It can't freeze. It requires no seat change when pressures change. It is small, inexpensive and easy to install.
Ask for Bulletin No. 250.

SARCO 9-100

110



FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

ARMY E NAVY

SARCO SAVES STEAM

Represented in Principal Cities

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

G.E. Leases Plants

THREE NEW appliance and construction materials' manufacturing plants have been leased by the General Electric Co., appliance and merchandise department, it has been announced by H. L. Andrews, vice president in charge of the department.

Wilms, Weaver Dissolved

THE FIRM OF Wilms, Weaver & Co., Suite 4045 Penobscot Building, Detroit 26, Michigan, has been dissolved by mutual consent, effective May 1, 1946.

Mr. Wilms will operate in the future as Walter H. Wilms & Co., specializing in general construction and marine equipment, with offices in the Guardian Building, Detroit, Mich.

Mr. Weaver will continue in the same general line as that followed by Wilms, Weaver & Co., under the firm name of Charles Weaver & Co., with headquarters in Suite 4045, Penobscot Building, Detroit 26, Mich.

Hooker-Detrex Corp. Formed

THE HOOKER-DETREX CORP. has been incorporated under the laws of the state of New York with a capitalization of 6,000 shares of preferred stock and 1,500 shares of common stock.

This is a corporation jointly owned by Hooker Electrochemical Co., whose main office is located at Niagara Falls, N. Y., and Detrex Corp., whose main office is located in Detroit, Mich.

The corporation has been formed for the purpose of manufacturing chlorinated solvents, the distribution and sales of which will be handled by the Detrex Corp.

Westinghouse Power Line Truck

A COMPLETE array of electrical distribution equipment under actual working conditions will be demonstrated all over the United States during the ensuing year by a specially designed truck. Equipped with the latest Westinghouse gear for the operation and protection of power distribution lines from source to customer, the truck will visit most of the larger public utilities, municipal, and R. E. A. power companies in the country during its trip.

The demonstration is based on the operation of a complete representative power line actually energized at 2400 v. This line, simulating some five or ten miles of construction is mounted on cross arms and insulators against a scenic background stretching for over thirty-five feet in length. It is complete with disconnect switches, boric acid fuse, automatic reclosing pole-type breaker, step-voltage regulator, completely self protected distribution transformer, lightning protective devices, primary shunt-connected capacitor, and even automatically operated tree branches to cause line troubles when wanted.

The effects of lightning have not been neglected. There is a 100-thousand v lightning generator to cause actual flashovers, and electrical storm troubles in any part of the line while it is energized at operating voltage. Lightning arresters and fuses can be operated at will under actual field conditions to protect transformer windings. Fault currents heavy enough to operate fuses and breakers under severe conditions are delivered by a specially designed motor-generator set with a heavy flywheel. Coordination of fuses and reclosers can be shown most graphically under any type of fault or overload conditions.

More detailed views of many of the distribution devices are given on the second side of the truck where cutaway sections are mounted to show the interior construction. Exhibits also include a wide assortment of street light heads and reflectors, various types of meters, and many other types of distribution equipment.

A dramatic view of street lighting units mounted on a standard ornamental pole can be demonstrated. While traveling, the pole and luminaire are suspended from a monorail along the top center of the truck. The pole is run out of the rear of the truck along the rail and is pivoted so that at the end of its travel, it can be swung into the vertical position and locked in place with the luminaire some twenty-five feet above the road surface.

During the first year, the truck is expected to cover over thirty thousand miles. It will be manned by two engineers especially qualified to handle and explain the operation of distribution equipment. Complete power for the demonstration can be taken from any convenient electrical outlet capable of supplying 60 amperes at 110 volts alternating current. If necessary, the nearest pole-line, 110-volt secondary could be used. The complete show including both demonstration and inspection requires approximately two hours.

Veterans Rejoin Bailey Meter

EIGHT ENGINEERS who have recently been released from military service, have rejoined the Bailey Meter Co. and have resumed their activities in instrumentation, combustion, and automatic control engineering.

These veterans have completed a refresher course at Bailey Meter factory in Cleveland, which brings them up to date on new equipment, procedures, and policies developed while they were away in service.

Most of these engineers are now located in the company's branch offices where they will assist power and process engineers in the application of suitable meters and controls for the improvement of operating efficiency and product quality.

The men have been assigned as follows: J. A. Lucas to his former position in the Cincinnati office; J. W. Herrington to his former position in the Atlanta office; J. E. Zimmerman to the Detroit office; A. L. Danielsen to the Denver district; S. T. Novak to the position of Quality Engineer at the Cleveland factory; H. R. Jamieson to the Proposition Department in Cleveland; H. C. Schink to the Boston office; Vincent Beno to development work in the company's Research Department.

Two engineers from the Canadian Army have recently returned to the company's Canadian subsidiary, Bailey Meter Company, Ltd., and after taking the refresher course at Cleveland, resumed their activities in Canada. They are: W. L. Thompson, Manager of the Toronto Branch Office, and W. A. Nelson of the Canadian Head Office at Montreal.

O. B. Schier, ASME Div. Secretary

OSCAR B. SCHIER II, has been appointed secretary to the standing committee on professional divisions of The American Society of Mechanical Engineers, 29 West 39th Street, New York.

Mr. Schier was recently discharged from the Navy, with the rank of lieutenant, after 33 months of service with the Office of Procurement and Material. Previously he was with the Consolidated Edison Co. of New York.

Books for War Victims

DURING THE WAR, the libraries of half the world were destroyed in the fires of battle and fanaticism. Where they were spared physical damage, they were impoverished by isolation. There is an urgent need for the printed materials which are basic to the reconstruction of devastated areas and which can help to remove the intellectual blackout of Europe and the Orient.

The American Book Center is collecting and is shipping abroad scholarly books and periodicals which will be useful in research and necessary in the physical, economic, social and industrial rehabilitation and reconstruction of Europe and the Far East.

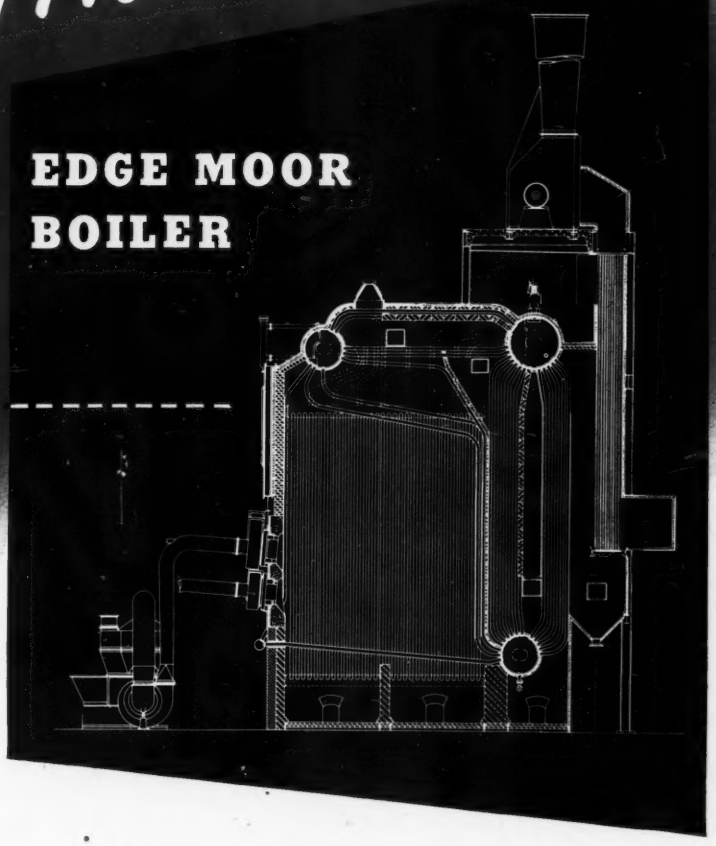
The Center cannot purchase books and periodicals; it must depend upon gifts from individuals, institutions, and organizations. Each state will be organized to participate in the program through the leadership of a state chairman. Other chairmen will organize interest in the principal subject fields. Cooperation with these leaders or direct individual contributions are welcomed.

Shipping facilities are precious and demand that all materials be carefully selected. Emphasis is placed upon publications issued during the past decade, upon scholarly books which are important contributions to their fields, upon periodicals (even incomplete volumes) of significance, upon fiction and non-fiction of distinction. All subjects—history, the social sciences, music, fine arts, literature, and especially the sciences and technologies—are wanted.

All shipments should be sent prepaid via the cheapest means of transportation to the American Book Center, c/o the Library of Congress, Washington 25, D. C. Although the Center hopes that donors will assume the costs of transportation of their materials to Washington, when this is not possible reimbursement will be made upon notification by card or letter of the amount due. The Center cannot accept material which is sent collect. Reimbursement cannot be made for packing or other charges beyond actual transportation. When possible, periodicals should be tied together by volume. It will be helpful if missing issues are noted on incomplete volumes.

85% EFFICIENCY...

FOR THIS **55,000 lb.** **EDGE MOOR BOILER**



Tests conducted by plant and outside engineers on this steam generating unit have shown a sustained overall efficiency averaging 85%—even when fired with pulverized fuels of widely varying analyses.

This boiler has been in operation since 1942 and was designed for firing with any of a wide range of coals available in the East. Of the 3-drum, radiant, bent-tube type, it is equipped with water walls at front, sides and screen bottom; air preheater; induced and forced draft fans, and a venturi stack. Capacity is 55,000 pounds steam per hour with a maximum peak load of 65,000 pounds at 650 psi.

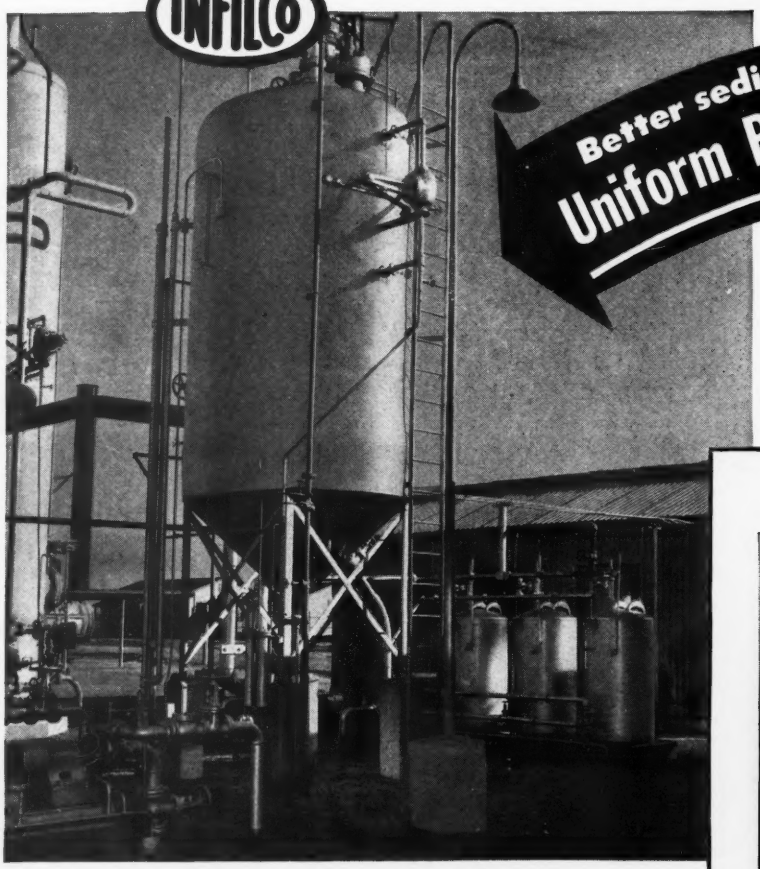
For the modernization of present facilities, or the building of new plants for any particular requirements, consult with Edge Moor engineers. Send for the new Edge Moor catalog which illustrates and describes the complete line of straight and bent-tube boilers—and all boiler auxiliaries.

EDGE MOOR IRON WORKS, INC., Main Office and Works, Edge Moor, Del. Branch Offices: 95 River Street, Hoboken, New Jersey, One No. LaSalle Street, Chicago 2, Ill.

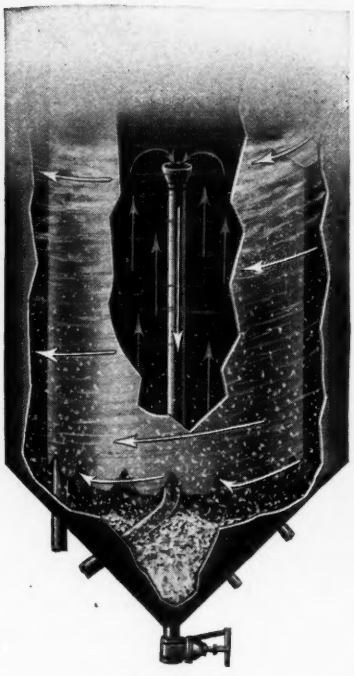
EM

EDGE MOOR Steam Generating Equipment

INFILCO



Better sedimentation produces
Uniform Boiler feed water



One unit solved *three* worries at this plant . . .

Raw water at this southern refinery is the troublesome type. Not *properly* treated, it could cause hard, glassy scale, sludge and foaming. Reasons for this not-too-happy outlook are silica, hardness and high alkalinity. So in installing treating equipment, guesswork wouldn't do. These were questions for considered answers . . . from INFILCO engineers.

In this case, as in many others, proper treatment centered around *effective* reactions with selected chemicals in the sedimentation tank. Dissolved silica, hardness and alkalinity had to be reduced to harmless amounts. These objectives were established by careful analysis of the raw water, and here are the results.

Thorough mixing of heated raw water and chemicals begins in the mixing compartment of the INFILCO Sedimentation Tank. From this turbulent zone, the water flows in a quiet spiral that allows time for *complete* chemical reaction. Reaching the bottom of the tank, it flows upward, fully treated, to the settled water take-off. That sequence continues its day-in, day-out job of removing the trouble-causing elements from the water at this plant. It's one of the examples of reliable analysis and dependable performance that characterizes Hot-Flow installations the country-over. INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.

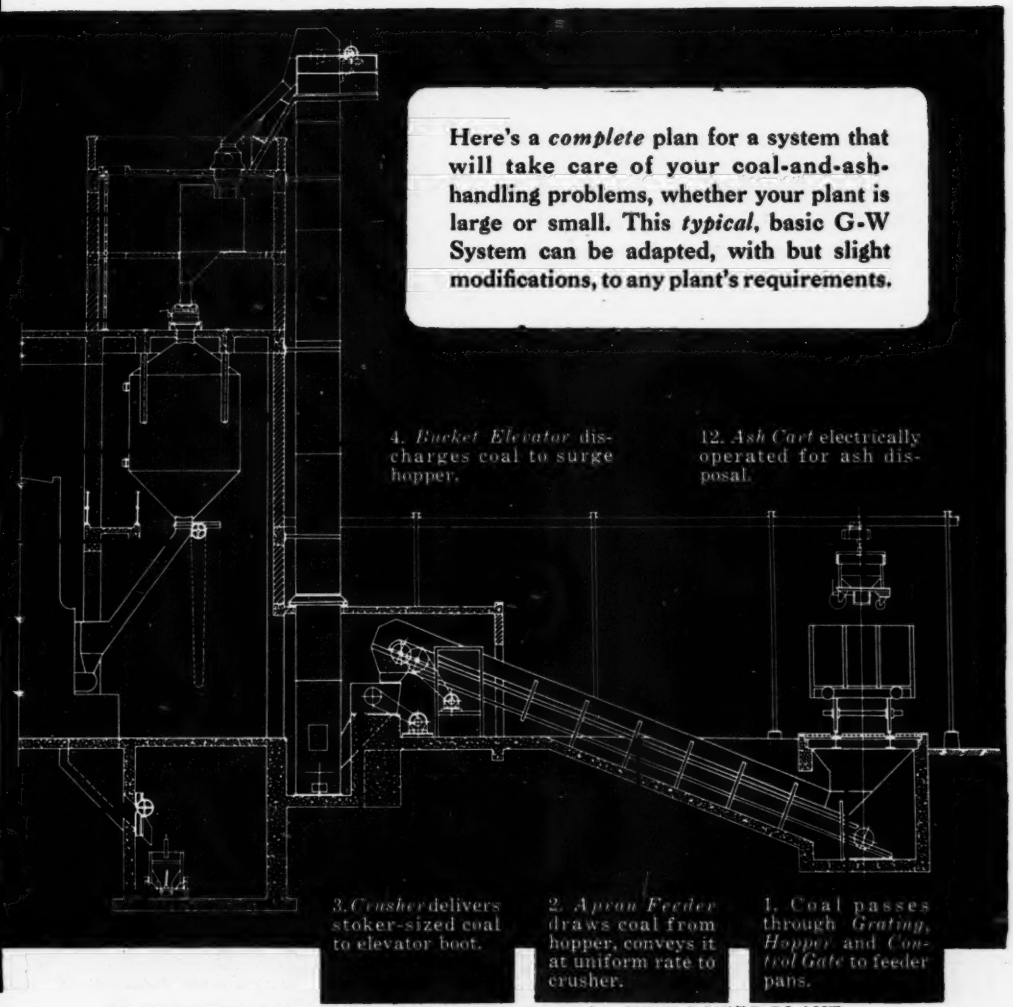
It's the *internal* design that produces *better* chemical mixing, *better* solids separation and *better* sedimentation in the Hot-Flow Tank.

Unique in construction, the interior is divided into three sections. An upper section is the mixing zone. This is divided, by a stilling plate, from an outer annular compartment, which is equal in volume with a central cylindrical uptake.

Thorough mixing of chemicals and thorough sedimentation in this tank always insure an adequate volume of properly treated feed water ahead of the filters.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

This *one* basic blueprint* solves *all* problems in coal-and-ash-handling


5. Surge Hopper Control Unit assures constant supply to scale.
6. Scale automatically weighs, records and discharges to shuttle belt conveyor.
7. Shuttle Belt Conveyor serves several bins from central weighing point.
8. Storage Bins have coal level control.
9. Control Gate and Spout to stoker.
10. Ash Unloading Gate.
11. Ash Cart manually operated through tunnel.
Here's a complete plan for a system that will take care of your coal-and-ash-handling problems, whether your plant is large or small. This typical, basic G-W System can be adapted, with but slight modifications, to any plant's requirements.
4. Bucket Elevator discharges coal to surge hopper.
12. Ash Cart electrically operated for ash disposal.
3. Crusher delivers stoker-sized coal to elevator boot.
2. Apron Feeder draws coal from hopper, conveys it at uniform rate to crusher.
1. Coal passes through Grating, Hopper and Control Gate to feeder pans.

*G-W SYSTEM NOW BEING BUILT FOR A 2,000 kw. UNIT POWER PLANT.

COAL IN... ASHES OUT

HANDLING HEADQUARTERS
for Industrial Conveying and Elevating Equipment . . . for Infra-Red Baking and Drying Equipment . . . for Ice Handling Tools and Ice Processing Machines.

G-W HANDLES IT...
faster • easier • cheaper

G-W will do the complete job. From start to finish G-W shoulders full responsibility for all details of design, manufacture, and erection. You save the time and money usually spent in dealing with sub-contractors. Two-way assurance that G-W will install the coal-and-ash-handling equipment that's best for your plant: hundreds of satisfied G-W equipment users; more than 130 years' experience in designing material-handling equipment for all types of industries. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill.—Factory: Hudson, N. Y.

1660

GIFFORD-WOOD
SINCE 1814

Let POWELL guide your way to assured, unfailing flow control

Through the ages, men on land and sea have been guided to their destination by the *North Star*. It is easy to find because it is almost in line with the two stars on the right end of the "Big Dipper."

Many years ago Powell patented the famous "Star" Regrinding Globe Valve. Today, the *Powell Star*, backed by 100 years of accumulated technical knowledge and manufacturing skills, is serving Industry as a guide to assured, unfailing flow control. The Complete Powell Line includes valves for every known industrial service and as new demands arise Powell Engineers will design valves to meet them.

Catalogs gladly furnished on request. Kindly specify whether you are interested in Bronze, Iron, Cast Steel, or Corrosion Resistant Valves.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc, Disc, when wide open, permits full, unobstructed flow through the valve body. Also available in All Iron.

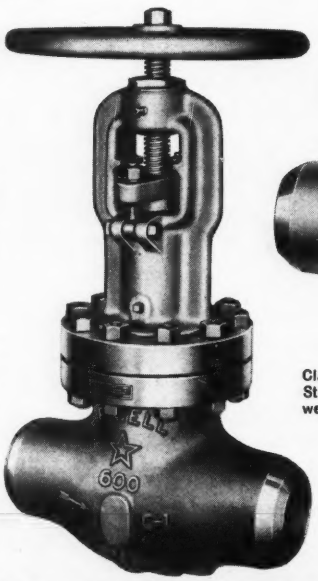


Fig. 6031 W. E.—Class 600-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke. Powell Cast Steel Valves of all types are available in pressure classes from 150 to 2500 pounds, inclusive.

Class 1500-pound, 6-inch, Cast Alloy Steel Gate Valve with welding ends and welded bonnet. Bevel gear operated.

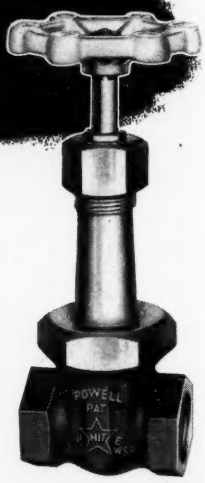


Fig. 375—Bronze "White Star" Gate Valve for 200 pounds W. S. P. Has screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

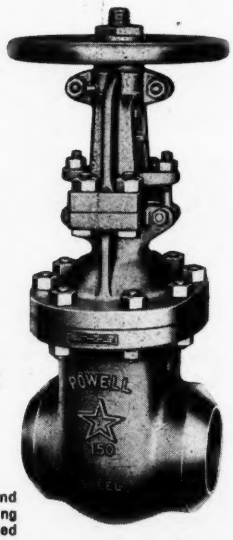


Fig. 1503 W. E. — Class 150 - pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

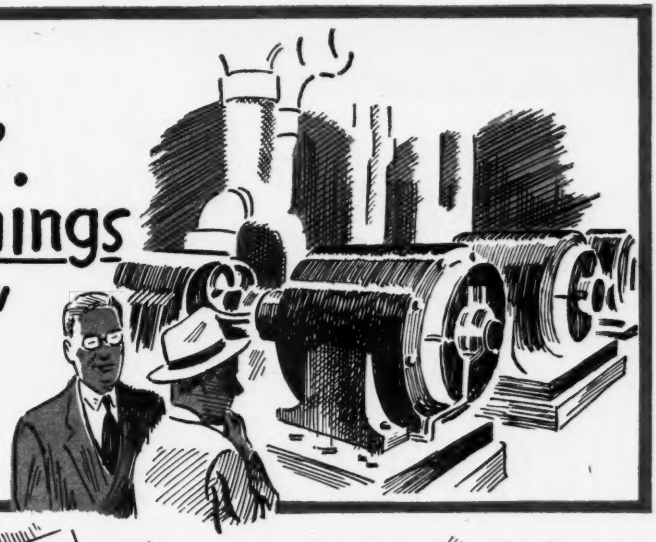
The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

"For This Job, Give Me Two Things in a Motor"

. . . said the Power Plant Engineer



"To Drive Boiler Feed Pumps, motors must first be *simple*. For example, take these three Allis-Chalmers 800 hp, 3600 rpm motors. They're 2-pole, squirrel-cage, single winding machines . . . with practically fool-proof rotors and sleeve bearings. But second, and even *more* important . . .

They've Got to be Dependable! Here's what I mean. These same motors have given us 17 years of uninterrupted service. We've had to order replacement parts for them only twice . . . at a total cost of less than $12 a year. We call that *good performance* . . . the kind we've come to expect of *all* your motors!"

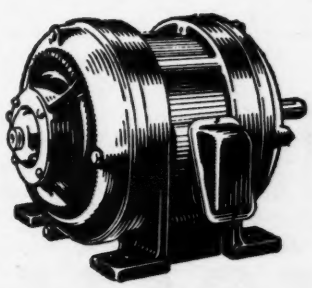
Frankly, Mr. Reader, we *are* mighty proud of our 2-pole motors. We've been developing them for high-speed requirements like this from the very earliest. Licked a lot of problems too. Like cutting down noise through better design . . . reducing windage noise with proper baffling, and curbing magnetic noise. . .

We're Getting Better Efficiencies and power factor . . . and lower starting kva, through improved squirrel-cage design. We've designed bearing brackets generously for greater structural rigidity. In fact, all the way around you can expect to find long life and low maintenance built-into our motors!

Yes, "A-C" Means Long Life in Motors!

REGARDLESS of size or type you'll be money ahead with Allis-Chalmers motors. For at A-C you can expect and *get* the same careful engineering, generous design and long-life operation that thousands of motor buyers have come to rely upon through the years.

And remember . . . while many jobs call for special or modified motors, there are *many more* that can be solved with *standard* motors . . . at less cost . . . and often with saving in time! ALLIS-CHALMERS, MILWAUKEE. A 2082



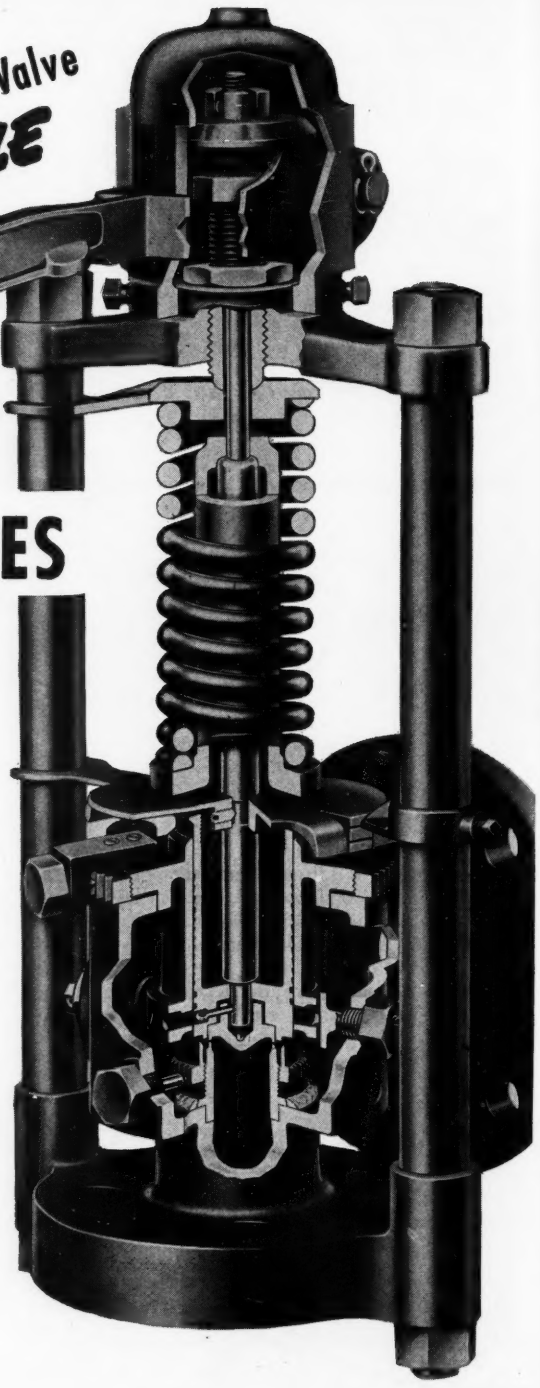
ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

You Can See for Yourself . . .

WHY the Foster 38-SV Safety Valve is ESPECIALLY SUITABLE FOR

HIGH PRESSURES HIGH TEMPERATURES



Pressures up to 3000 pounds and temperatures of 1200° F. are easily handled by the Foster Type 38-SV Super-Jet Safety Valve—it was designed especially for just these exacting requirements! It's no mere "beefed-up" low-pressure valve—rather it's a basic new design for high-pressure service.

Only the Foster 38-SV Safety Valve gives you all these advantages:

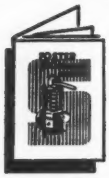
1 . . . ***Exceptional steam economy*** because . . . it reseats as low as 1% below popping pressure . . . reseating is positive; without pounding or chatter . . . blowdown is adjustable from 8% down to 1%.

2 . . . ***Unaffected by temperature changes*** because . . . frame rod construction makes crawl negligible . . . deflector protects spring and rods from escaping steam.

3 . . . ***Maximum protection*** because . . . full opening is practically instantaneous . . . full rated nozzle capacity is available at popping pressure . . . once set under operating conditions, its popping point is constant.

4 . . . ***Positive reseating*** because . . . floating disc design . . . steam-centered piston . . . permanently flat seats.

Specify the Foster 38-SV Super-Jet Safety Valve for the finest in high-pressure protection!



Complete details of the Foster 38-SV Super-Jet Safety Valve, for pressures up to 3000 pounds and temperatures up to 1200° F., are given in Bulletin 25. Write for it today!

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.

FLAMENOL CABLE

for wiring that's EASY TO IDENTIFY

HARD TO HURT

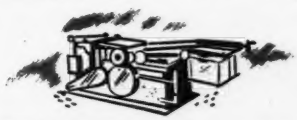
Electric circuits on machines, panelboards, control devices and the like are easily traced and identified when wired with Flamenol Cable. The smooth, impervious insulation of Flamenol *stays* bright and clean. Seven colors provide for permanent coding of complex circuits.

Once wired with Flamenol, electric circuits are well protected for the full life-span of the machine. All the usual causes of insulation damage have little if any effect on the insulation of Flamenol, as these actual cases show:

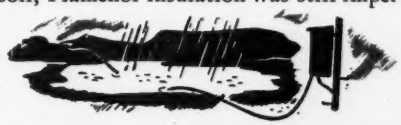
OIL WON'T HURT IT—In a chemical process plant, leads to oil-immersed motor controls were a constant source of trouble, until rewired with Flamenol. They've never given trouble since.

MILD ACIDS AND ALKALIES WON'T HURT IT—Used to wire a battery-charging set-up, Flamenol didn't fail despite "dunking" with electrolyte. In paper-mill wiring, it stood up against alkalies.

SOLVENTS WON'T HURT IT—Flamenol ended wiring troubles on printing presses where inks splashed on the wiring.



MOISTURE WON'T HURT IT—After 7 years underground in damp soil, Flamenol insulation was still impervious.



AGE WON'T HURT IT—In a seven-year test under Florida sunlight, the insulation on Flamenol cable showed no signs of deterioration.

ANOTHER G-E ACHIEVEMENT RESULTING FROM "FULL-RANGE" RESEARCH

Long before the rubber shortage, G.E. had been seeking a "better-than-rubber" insulation for low-voltage wire and cable; an insulation that would be slow to age, hard to burn, and able to resist acids, oils, water, and alkalies. Soon, chemists in the G-E laboratories produced such an insulation from plasticized polyvinyl chloride. G-E process engineers then took the new insulation, and prior to 1936 had solved the problem of its application to a conductor on a practical basis. The result was Flamenol, the first wire and cable to be insulated with long-lived, tough, plasticized polyvinyl chloride—another G-E first. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

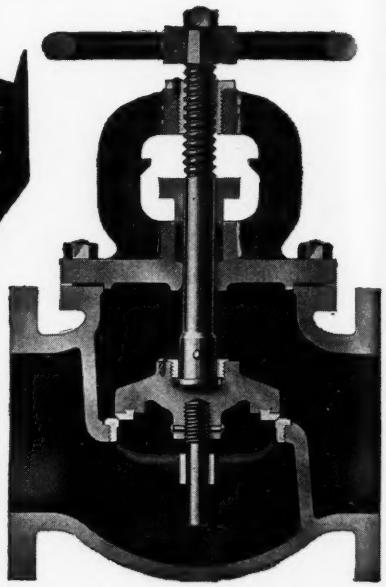
GENERAL ELECTRIC

502-58-1200

Every feature you want in an

IRON BODY GLOBE or ANGLE VALVE

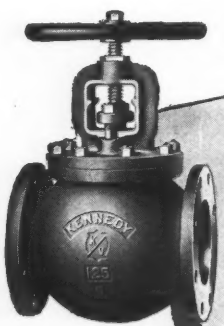
is in the KENNEDY DESIGNS



Notice the generous proportions, wide passageways with long curves, sturdy ribbed yoke with separate yoke nut, large handwheel, guided self-seating disc, renewable seat ring, and provisions for securely locking the disc, guide pin and yoke nut in place.

These are some of your assurances of extra strength and extra service when you install a Kennedy Iron Body Globe or Angle Valve. These valves are made in a full range of sizes for 125 lb., 150 lb., 175 lb. and 250 lb. steam pressure, with bronze-faced or renewable composition discs, and are also available in cross valve type. They are fully described in the 240-page Kennedy Catalog, which describes the entire Kennedy line of iron body and bronze gate, globe and check valves, malleable iron and bronze screwed pipe fittings, and cast iron flanged fittings and flanges. Write for your copy today.

Buy From Our Distributor



YOU WANT THESE VALVE FEATURES

. . . you'll find them in this KENNEDY design

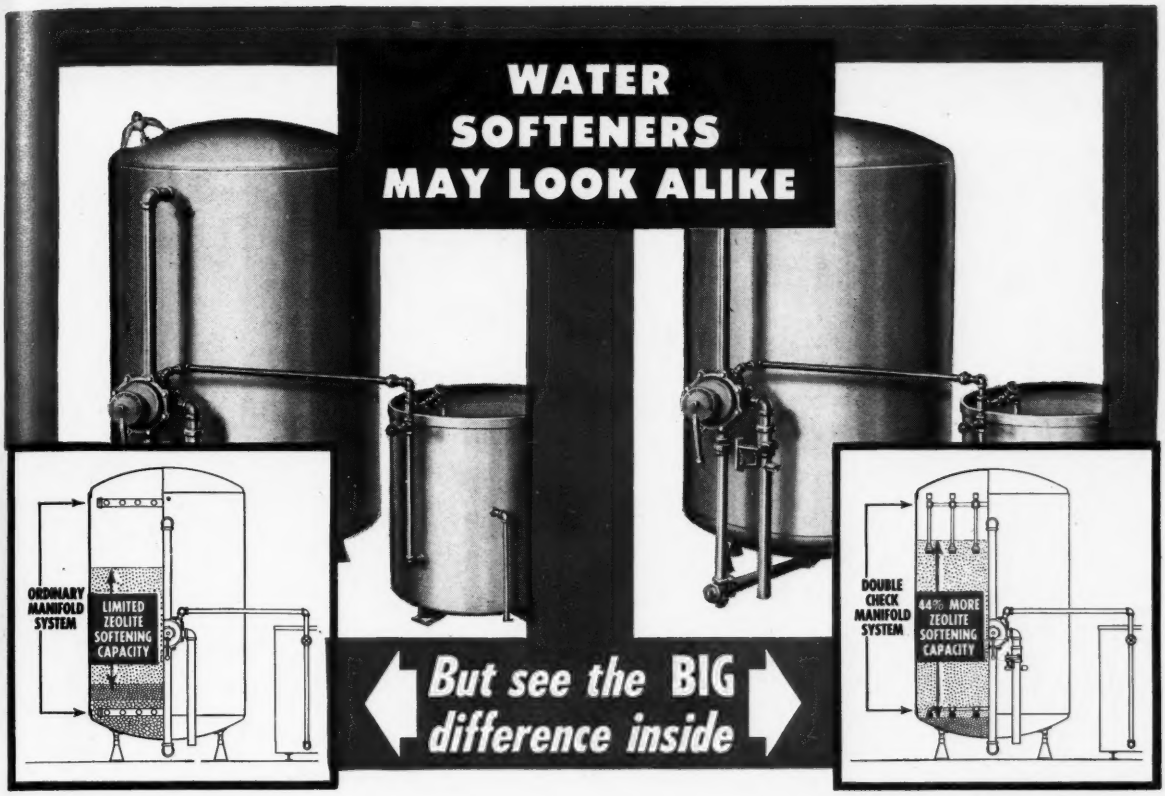
1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-134

KENNEDY *valves - pipe fittings - fire hydrants*

WATER SOFTENERS MAY LOOK ALIKE


ORDINARY MANIFOLD SYSTEM
LIMITED ZEOLITE SOFTENING CAPACITY
But see the BIG difference inside
DOUBLE CHECK MANIFOLD SYSTEM
44% MORE ZEOLITE SOFTENING CAPACITY

ORDINARY SOFTENER **IMPROVED ELGIN SOFTENER**

It so happens that all water softeners are pretty much alike in outward appearance. But there the resemblance ends. Look inside the Elgin and you'll see an important difference — the new Elgin "Double-Check" manifold system.

The diagrams show how this increases capacity by permitting a deeper softening bed without loss of zeolite — a loss that ordinary softeners attempt to avoid by limiting the depth of the zeolite bed. Look further and you'll see how this improved manifold system brings many more unmatched softener features as listed at right.

Whatever your hard water problem, remember that in the final analysis, water softening capacity is what you buy. Examine all softeners in this light and you'll see why the new Elgin ranks as one of the great advances in water conditioning. New bulletin giving all the facts is yours for the asking.

No Other Softener Offers—

- Lower First Cost
- Lower Operating Cost
- Higher Efficiency
- Less Maintenance
- Longer Life
- Less Space Required

THE IMPROVED ELGIN GIVES 44% MORE SOFT WATER

Modernize your old softener

Using the ingenious "Double-Check" manifold arrangement, it is a simple matter to convert any water softener to Elgin design. When supplemented by high-capacity Elgin Zeolite this modernization provides up to 44% more soft water and reduces operating and maintenance costs. The cost is surprisingly low. New bulletin tells all about it.

Let your nearest Elgin Engineer help you plan

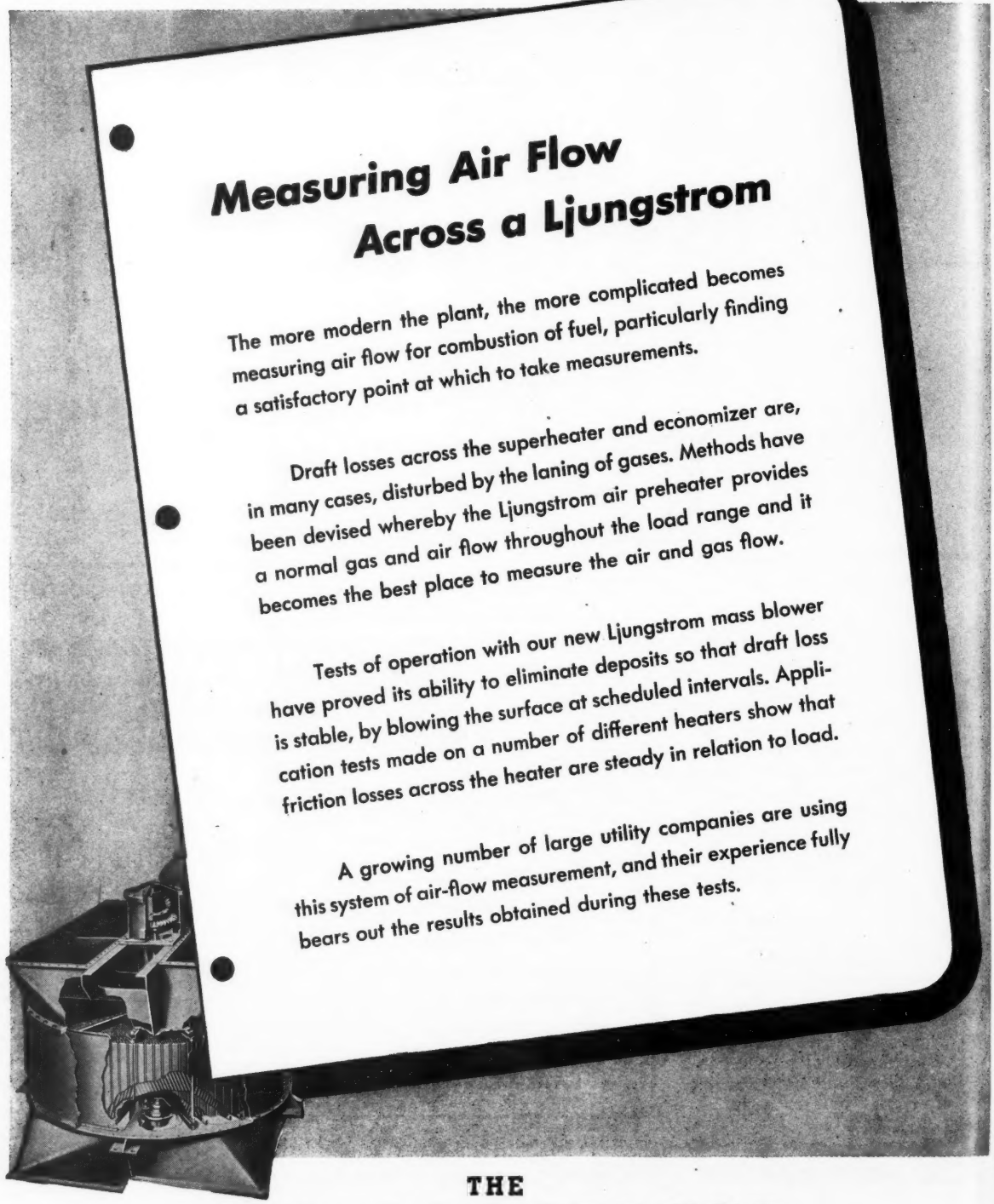
NEW BULLETIN 608 has all the facts. Write for your copy.

ELGIN SOFTENER CORPORATION

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

ENGINEERING PROGRESS REPORT # 3

LJUNGSTROM AIR PREHEATER



Measuring Air Flow Across a Ljungstrom

The more modern the plant, the more complicated becomes measuring air flow for combustion of fuel, particularly finding a satisfactory point at which to take measurements.

Draft losses across the superheater and economizer are, in many cases, disturbed by the laning of gases. Methods have been devised whereby the Ljungstrom air preheater provides a normal gas and air flow throughout the load range and it becomes the best place to measure the air and gas flow.

Tests of operation with our new Ljungstrom mass blower have proved its ability to eliminate deposits so that draft loss is stable, by blowing the surface at scheduled intervals. Application tests made on a number of different heaters show that friction losses across the heater are steady in relation to load.

A growing number of large utility companies are using this system of air-flow measurement, and their experience fully bears out the results obtained during these tests.

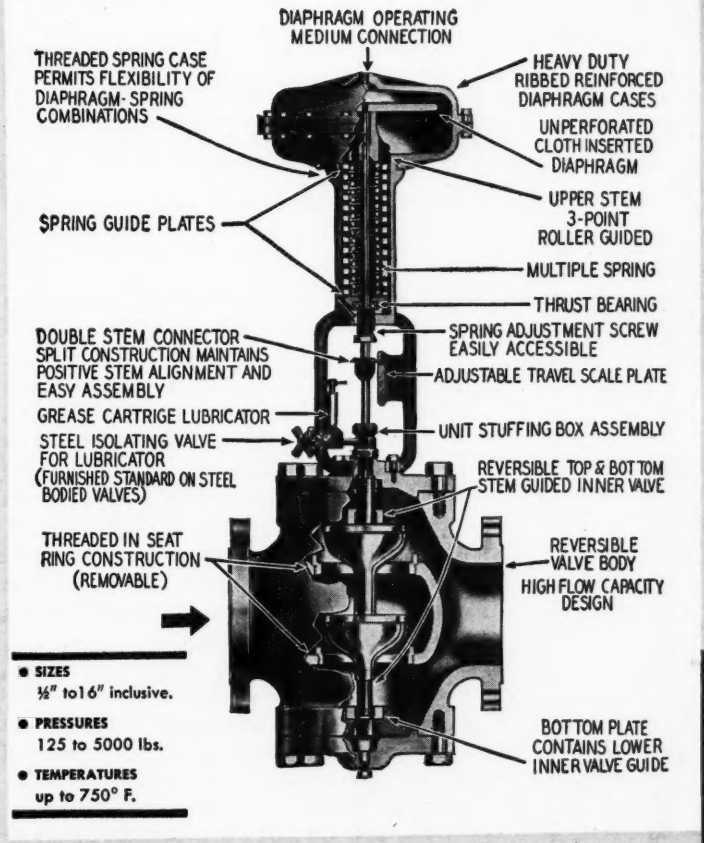
THE

AIR PREHEATER

CORPORATION

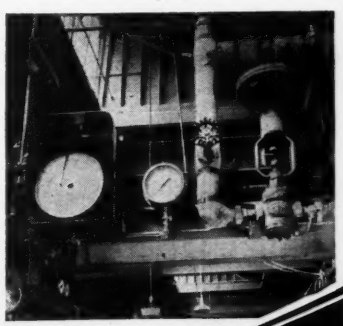
Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Design for *Better* PROCESS CONTROL


DIAPHRAGM OPERATING MEDIUM CONNECTION
THREADED SPRING CASE PERMITS FLEXIBILITY OF DIAPHRAGM-SPRING COMBINATIONS
HEAVY DUTY RIBBED REINFORCED DIAPHRAGM CASES
UNPERFORATED CLOTH INSERTED DIAPHRAGM
UPPER STEM 3-POINT ROLLER GUIDED
SPRING GUIDE PLATES
MULTIPLE SPRING
THRUST BEARING
SPRING ADJUSTMENT SCREW EASILY ACCESSIBLE
DOUBLE STEM CONNECTOR SPLIT CONSTRUCTION MAINTAINS POSITIVE STEM ALIGNMENT AND EASY ASSEMBLY
ADJUSTABLE TRAVEL SCALE PLATE
GREASE CARTRIGE LUBRICATOR
UNIT STUFFING BOX ASSEMBLY
STEEL ISOLATING VALVE FOR LUBRICATOR (FURNISHED STANDARD ON STEEL BODIED VALVES)
REVERSIBLE TOP & BOTTOM STEM GUIDED INNER VALVE
THREADED IN SEAT RING CONSTRUCTION (REMOVABLE)
REVERSIBLE VALVE BODY
HIGH FLOW CAPACITY DESIGN
BOTTOM PLATE CONTAINS LOWER INNER VALVE GUIDE
• SIZES ½" to 16" inclusive.
• PRESSURES 125 to 5000 lbs.
• TEMPERATURES up to 750° F.

as exemplified in a *Superior*

MOTOR DIAPHRAGM VALVE



THE NEW McALEAR TYPE H-86 MOTOR DIAPHRAGM VALVE, here shown, like other McAlear Automatic Controls, meets new and unusually critical requirements resulting from recent technological advancements in process industries.

In the processing of high octane gasoline, synthetic rubber, resins, plastics, chemicals, etc., wherever advanced new methods—employing abnormally high pressures and temperatures—call for controls of greater sturdiness and higher precision, McAlear Controls are maintaining continuous, uninterrupted production.

BRING YOUR CONTROL PROBLEMS TO McALEAR. Draw on the wide experience of McAlear engineers . . . on their readiness and willingness to help you. For informative bulletins or catalog, write McAlear Manufacturing Company, Automatic Control Division of Climax Industries, 1915 S. Western Avenue, Chicago 8, Illinois.

CLIMAX INDUSTRIES

McALEAR controls

PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

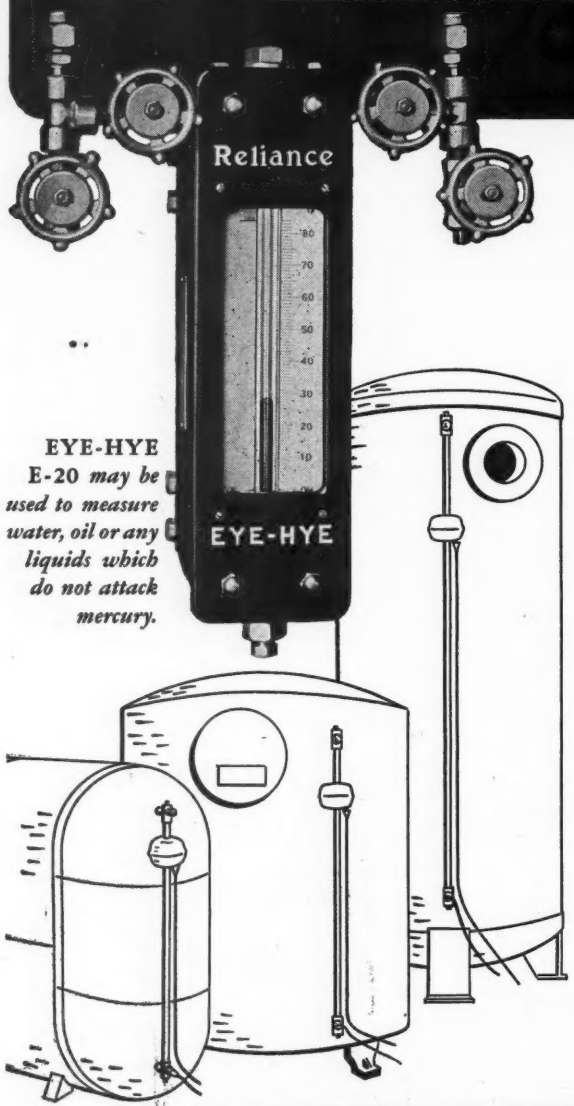
for STEAM, WATER, AIR, OIL—GAS

NEW HIGH LEVEL GAGE

gives you safe accurate reading with remote location convenience

. . . Your tanks and vessels holding liquid levels up to 12 feet now can be read by

Reliance EYE-HYE



EYE-HYE E-20 may be used to measure water, oil or any liquids which do not attack mercury.

This new model EYE-HYE, the E-20, brings you new convenience and efficiency in checking liquid levels having a high variation factor. It's valuable to know you can read *accurately* up to 12 feet of liquid by a sharply defined, illuminated indicating column no higher than 12 inches. The window can be located above or below and a reasonable distance away from the container — on wall or instrument panel. Reliance has perfected and tested in actual installations this new model EYE-HYE which operates on the same general principle as those you've used (or seen) in many power plants.

Using mercury as the indicating medium, liquid levels greater than encountered in boilers and other vessels are condensed to a fraction of their actual footage — are measured by a "black" mercury column against a window face plate scaled to suit your needs.

The new EYE-HYE E-20 places a much-desired direct-reading (no interpretation required) eye-level gage at your command for safer supervision of unusually high liquid levels. Write today for Bulletin 450.

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

M
KELLOGG
W

IMPRESSIVE FIGURES!

SINCE PEARL HARBOR

(Advertisement printed December, 1941)

STILL MORE IMPRESSIVE TODAY!
4 VERY IMPRESSIVE FACTS
18,221,000 lb. per hr. Steam Generated
1,102,500 K.W. per hr. Capacity
900°F. to 950°F. Temperature Conditions
720 to 2200 lb. Pressure Range
KELLOGG

35,541,500 lb. per hr.
STEAM GENERATED
18,221,000 lb. per hr. in 1941

2,355,000 k.w. per hr.
CAPACITY (High Pressure Units Only)
1,102,000 K.W. per hr. in 1941

900°F. to 1000°F.
TEMPERATURE CONDITIONS
900°F. to 950°F. Temperature Conditions in 1941

650 to 2200 lb.
PRESSURE RANGE
720 to 2200 lb. Pressure Range in 1941

These figures show the confidence placed by Consulting Engineers, Central Station and Industrial Power Plant Engineers, in Kellogg's ability to design, fabricate and erect piping installations, which perform as required, under the most advanced techniques of pressure and temperature.

While the figures show only high pressure installations, The Kellogg Company has also prefabricated and erected many piping jobs for lower pressures.

KELLOGG

"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES:

LOS ANGELES: 609 SOUTH GRAND · HOUSTON 2, TEXAS 402 ESPERSON BLDG · TULSA PHILTOWER BLDG

TOP EFFICIENCY *for* CONSERVING HEAT—SAVING MONEY

Effective up to 1800° F.—this easy-to-apply, insulating cement does not break down under service conditions . . .

Here are some figures to indicate how B-H No. 1 Insulating Cement cuts down heat losses, when used on valves:

ASSUMPTIONS: 70° F.—temperature of surrounding still air; 350° F.—hot surface temperature (120 lb. steam); coal at 13000 BTU per lb., utilized at 60% efficiency.

Valve Size	*Insulation Thickness*	*Yearly Saving Per Valve*
3" Globe (screwed)	1"	335 lb.
3" Gate (screwed)	1"	313 lb.
6" Globe (screwed)	1"	831 lb.
6" Gate (screwed)	1"	559 lb.

On flanged valves the saving would be approximately five times as much.

Similar savings are effected when this cement is used on piping, flanged couplings, drum or tank ends, and all irregular surfaces not suited to molded insulations.

Two facts account for the *extra years* of efficient service you get from this product. First, its base is nodulated B-H *black* Rockwool—which keeps its physical properties; the dead air cells mean both maximum insulating efficiency and light weight. Second, a special rust-inhibitor safeguards the metal against corrosion, insures a lasting, firm bond.

B-H No. 1 Cement is easy to use, easy to store—efficient up to 1800° F., reclaimable up to 1200°—ideal for maintenance work.

Use the coupon below to secure a practical sample and an illustrated folder of performance charts and data—together with general application recommendations.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

BH

Baldwin-Hill Co., 606 Breunig Ave., Trenton 2, N. J.

Send information on products checked below:

☐ Free sample of B-H No. 1 Cement

☐ No. 100 Pipe Covering—effective up to 1200°F. (for long runs overhead, underground, Diesel exhausts)

☐ Mono-Block—the one-block insulation for all temperatures up to 1700°F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

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CITY _____ ZONE _____ STATE _____

NEWS *from* THE FIELD

Kellogg Retires as President of EEI

THE RETIREMENT ON June 30 of Charles W. Kellogg, President of the Edison Electric Institute, officially terminated a career of 43 years of distinguished service to the electric utility industry. During this time, Mr. Kellogg served as an operating and a holding company executive, and in his present position as head of the principal trade association of the electric utility industry.

Born in Philadelphia in 1880, Mr. Kellogg received the degrees of BS (1902) and MS (1903) from M. I. T. After graduation, he joined the utility concern of Stone & Webster—a connection that was to last for 36 years.

He was appointed manager of the Edison Co. in Brockton, Mass., a Stone & Webster affiliate, in 1905. Mr. Kellogg shortly thereafter was transferred to Texas, where he spent nine years as manager of Stone & Webster operating companies in El Paso and the Gulf Coast area.

From 1914 to 1919, he was the manager of the Mississippi River Power Co. at Keokuk, Iowa. During the latter part of this period, he was also the manager of Stone & Webster's Middle West District.

Assigned to the Stone & Webster Boston office in 1919, Mr. Kellogg spent the next six years in work on appraisals, reports, etc. He was elected President of Engineers Public Service Co. shortly after its organization by Stone & Webster and associated interests in 1925. He became Chairman of the Board in 1933, and continued in this post until 1939.

In June 1940, he was asked to serve for a three months' period as Chief Consultant of the Light, Heat and Power Unit of the Defense Commission, predecessor of the War Production Board. On leave of absence from the Institute, this three months' period was extended to a full-year, in which he devoted practically all of his time to organization of the public utilities in the defense program.

CED Issues Handbook

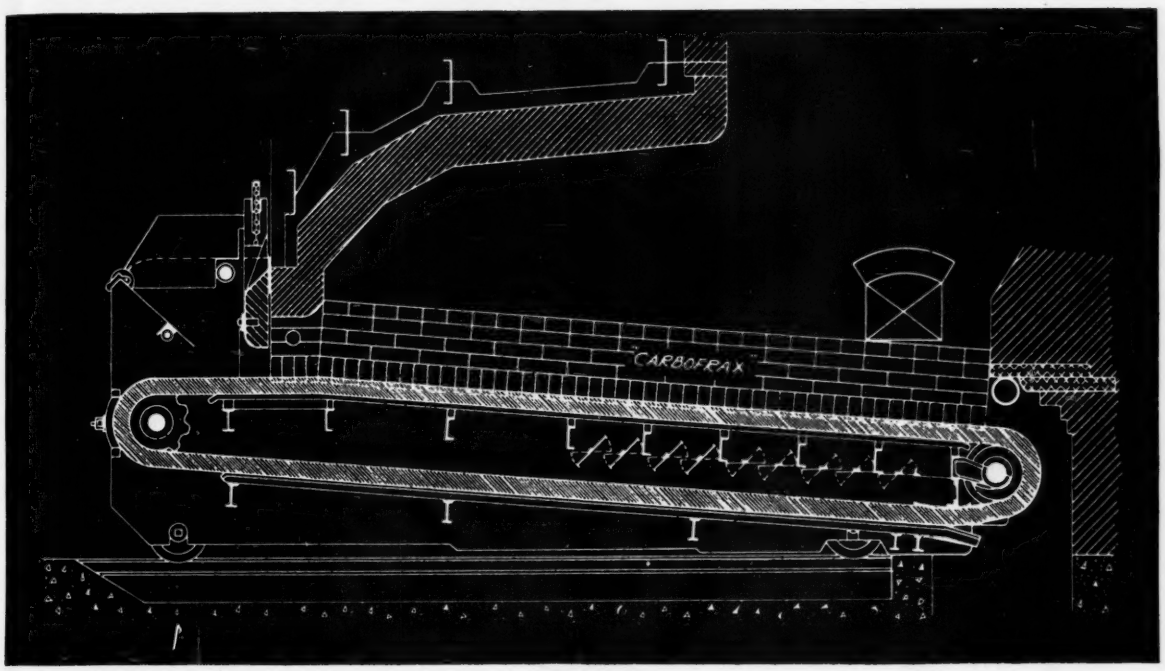
REALIZING THE need for the fullest possible information for American manufacturers regarding the development of markets abroad, the Committee for Economic Development obtained the cooperation of 10 organizations whose activities are concentrated on export problems in producing "A Handbook of International Trade." This one hundred page handbook is an extremely helpful and authoritative treatise on this subject.

Primarily, this handbook is divided into two parts plus an appendix. Part One deals with export for the manufacturer. Part Two deals with import for the manufacturer, wholesale distributor and retailer. Each of these two parts is treated in a succession of steps expressed with clear thought

WALL BRICK DATA

LACLEDE Natural Draft STOKER

Prevent Clinkers from hampering Furnace Efficiency



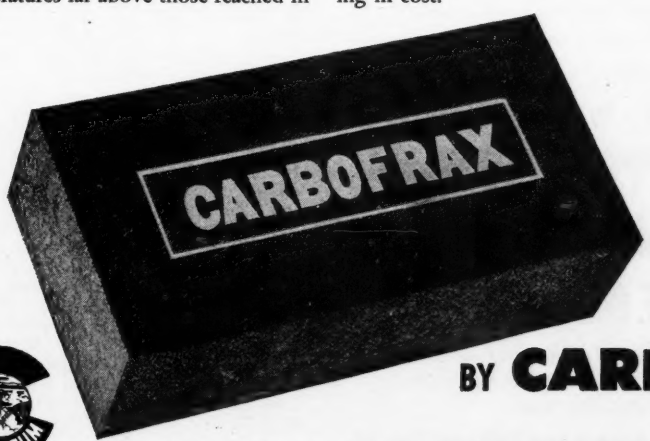
The efficient performance of a Laclede Stoker is greatly improved by using CARBOFRAX silicon carbide brick in the boiler walls. A typical installation is shown by the illustration.

Trouble causing, space consuming clinkers cannot form on the dense surface of CARBOFRAX brick. These brick remain hard and impenetrable at temperatures far above those reached in normal operation. With no softening of the brickwork, the moving fuel bed helps to clean the walls. Any accumulations remaining are easily barred off.

Unrestricted by choking clinker formations, the fire is active over the entire grate area. Fuel is burned more efficiently . . . more economically. Greater furnace capacity is realized with a decided saving in cost.

Production is uninterrupted by the frequent repairs usually experienced when ordinary refractories are used. The resistance of CARBOFRAX brick to mechanical abrasion, spalling and cracking is particularly noteworthy. Reports from the field of steady service from 8 to 10 years are not exceptional. And since CARBOFRAX brick do not burn or cut back, upper walls do not require the repair and maintenance otherwise expected.

A thorough investigation of the advantages provided by CARBOFRAX settings often leads to beneficial results. Engineering details can be quickly and easily found in our specially prepared booklet "CARBOFRAX in Boiler Furnaces." Write Dept. H-86 for your copy today. The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



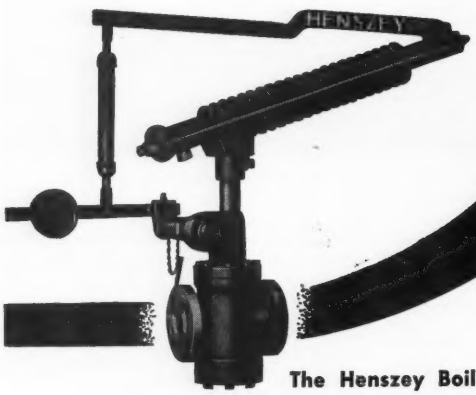
BY CARBORUNDUM
TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

GOES RIGHT IN THE LINE . . . .

The **HENSZEY**
BOILER FEED REGULATOR
offers

SIMPLE but EFFECTIVE BOILER WATER LEVEL CONTROL CONTINUOUSLY, AUTOMATICALLY, and ACCURATELY under ALL LOAD CONDITIONS . . .



The Henszey Boiler Feed Regulator is made for pressures up to 600 lbs. and in pipe sizes up to four inches. No additional structural supports are needed . . . once installed and set for operation, no further attention is necessary.

HENSZEY COMPANY, Dept. C8, Watertown, Wis.

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

and in understandable English. This handbook is priced at fifty cents and is distributed by the Committee for Economic Development, 285 Madison Ave., New York 17, N. Y.

Snell New Head of Chemists' Group

DR. FOSTER DEE SNELL, president of Foster D. Snell, Inc., Consulting Chemists and Engineers of 305 Washington Street, Brooklyn 1, New York was elected president of the American Institute of Chemists at its annual meeting held May 17th at the Hotel Biltmore, succeeding Dr. Gustav Egloff of Universal Oil Products Co., Chicago.

Dr. Joseph Mattiello, technical director of the Hilo Varnish Co., was elected as vice president, succeeding Dr. Donald Price, Technical director of Oakite Products, Inc., New York. At the same meeting reelection of Dr. Lloyd Van Doren, patent attorney of New York as Secretary and Frederick A. Hessel, president of the Montclair Research Corp. of Montclair, N. J. as Treasurer was announced.

New councilors elected for three years were Dr. Donald B. Keyes, vice president of Hayden Chemical Corp.; Dr. Raymond E. Kirk, dean of the graduate school and head of the department of Chemistry of The Polytechnic Institute, Brooklyn, New York; and Dr. Donald Price.

New Unit for Grand Coulee

OPENING A new era in power production in the Pacific Northwest, the Bureau of Reclamation has called for bids on a 165,000 hp turbine, the world's mightiest, to drive the largest hydroelectric generator which will be installed in the recently completed right powerhouse at Grand Coulee Dam.

Companion structure to the left powerhouse which has produced more than 18 billion kw of electrical energy, the right powerhouse is designed to serve nine generators. The first unit to be installed will be rated at 120,000 kw.

Although similar to those in the left powerhouse, the first unit in the right powerhouse will have a higher rating, 120,000 kw compared with 108,000 kw. During the war, the 108,000 kw generators in the left powerhouse operated continuously under loads of 120,000 and greater.

BCR Appointments

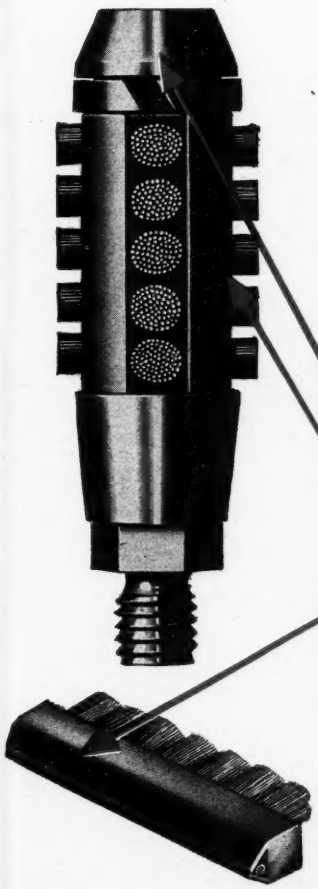
BITUMINOUS COAL RESEARCH, INC., has made three appointments to the BCR Technical Advisory Board, naming C. R. Mabley, Jr. of Huntington, W. Va., John Mitchell of Boston, Mass., and Charles J. Surdy of New York City.

Mr. Mabley, a former colonel in the Army of the United States, is general manager of industrial sales for Island Creek Coal Sales Co. Mr. Mitchell, a gas engineer, represents the Koppers Coal Division of Eastern Gas & Fuel Associates. Mr. Surdy is vice president of The Standard Stoker Co., Inc.

ANOTHER WILSON FIRST!

NEW EXPANDING BRUSH CLEANS 1/2" I. D. TUBES

exclusive Wilson features assure efficiency and economy



For years the problem of removing deposit from very small tubes has stumped tube cleaning experts in the marine and power plant fields and driven them to expensive tube removal, pickling and replacement.

Now the need for this has been eliminated! Wilson engineers have developed a new expanding brush specially designed to clean the small tubes in heat exchangers, evaporators, condensers and similar equipment without necessity of removing tubes *or* bundles. This compact little brush — the smallest yet developed — removes light scales and other deposits in tubes as small as ½" I.D.

Small as it is, the *new* expanding brush incorporates features which have long enabled Wilson expanding brushes to make fast work of removing deposits for which they are designed. Here are just three of the many features.

1. **Replaceable retainers and caps take wear. Brush is as good as new when inexpensive cap is replaced.**
2. **Special case hardened steel makes possible longest brush body life.**
3. **Exclusive patented one piece cartridge design; substantial channel walls prevent tufts from "punching through" while solid, long-wearing side walls together with special bristles of steel, bronze, tampico, or nylon assure longest brush life.**

There is a Wilson Expanding Brush for every tube from ½" I.D. up . . . ferrous or non-ferrous, straight or curved.

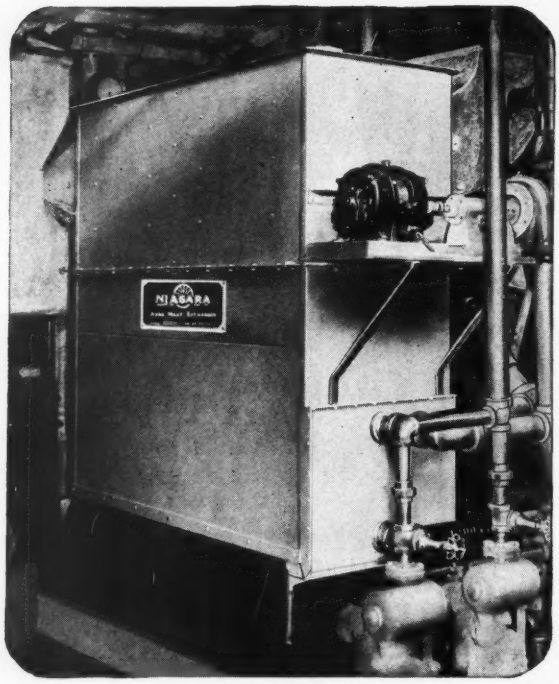
Immediate delivery from stock. Write for additional information, addressing all communications to Dept. N.

THOMAS C. WILSON, INC., 21-11 44th Avenue, Long Island City 1, N. Y.

WILSON

TW-711

TUBE CLEANERS



Trustworthy Water Jacket Cooling for Industrial Power Equipment

Ample cooling capacity, with freedom from the maintenance troubles of open-system water cooling, supports higher production.

The NIAGARA AERO HEAT EXCHANGER provides a closed system of re-circulated, clean jacket water at a controlled temperature. Operating your diesel or gas engines or other machinery at the correct temperature assures you of full-rated power, and freedom from frequent shut-down and mechanical trouble.

Using the NIAGARA AERO HEAT EXCHANGER also provides operating economies that quickly pay for the equipment. The heat is removed by air and the high cost of cooling water is eliminated.

Write for Bulletin 96 for complete information.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. PP-86, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

A.C., Refrig. Market to Expand

AN UNPARALLELED market expansion for air conditioning and refrigerating equipment was forecast by S. E. Lauer, President of the York Corp. of York, Pa., whose election as President of the Air Conditioning and Refrigerating Machinery Association was announced recently by the Association.

Mr. Lauer stated that the industry's greatly enlarged plant capacity, which was more than double for wartime manufacture, probably can be fully employed to meet current and prospective demands for improved types of refrigerating and air conditioning machinery.

Revenues Increase

ELECTRIC OPERATING revenues of the larger privately-owned electric utilities in the United States in April 1946 were $263,178,000, as compared to $257,895,000 in April 1945, an increase of 2.0 per cent, according to preliminary figures just announced by the Federal Power Commission in advance of its monthly report in the series entitled "Sales, Revenues, and Income of Privately-Owned Class A and Class B Electric Utilities in the United States."

Revenue deductions (including operating expenses, depreciation and taxes) were $198,300,000, a fractional percentage under those of April 1945.

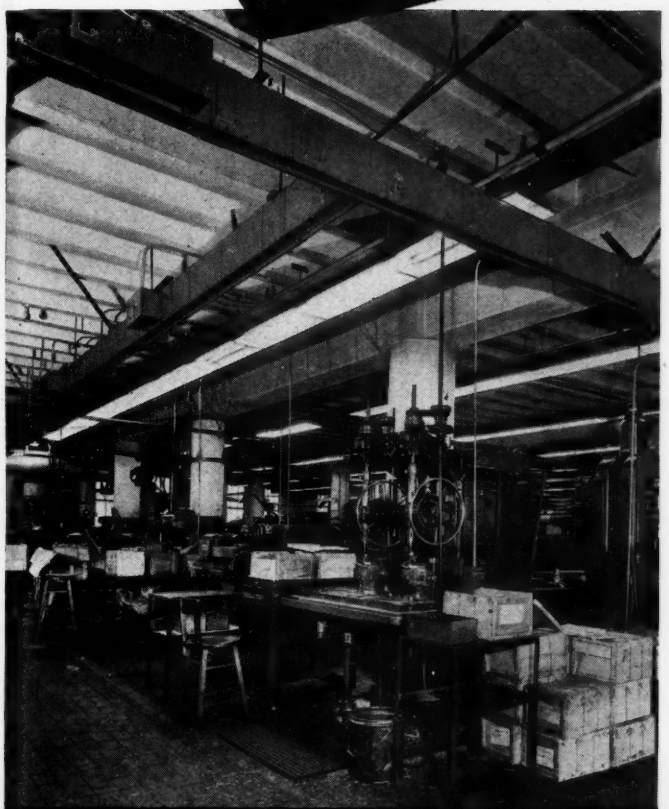
Gross income, including other utility operating income, increased 10.5 per cent to $74,864,000 and net income in April 1946 was $53,130,000, an increase of 32.8 per cent from the net for April 1945.

Dale Hollow Hydro-Plant

UNITED STATES ENGINEER Office, Nashville, Tenn., will begin work soon on new hydroelectric generating station at Dale Hollow on Obey River, about 3 miles from Celina, Clay County, Tenn., originally projected a number of months ago, when dam was constructed at that place and since used for flood control service. This dam, a concrete gravity type structure, has a maximum height of approximately 200 ft. At time of building, 1942-43, portion of power station substructure likewise was completed. Superstructure will be built by Morrison-Knudsen Co., Boise, Idaho, which recently tendered low bid of $1,720,246 for work. It will be a multi-story, reinforced-concrete structure, with generator room designed for three main hydraulic turbine units of 54,000 kw gross rating, two of which will be installed at present time. Each will consist of a 25,000-hp hydraulic turbine, to be furnished by S. Morgan Smith Co., and 18,000-kw electric generator, which will be supplied by Westinghouse Electric Corp. A storage reservoir has been constructed to provide a total of 1,353,000 acre-ft for power service, giving a normal operating head of 140 ft. In addition to main generating units, an 850-hp station service water turbine will be fur-

this is PLANNED ECONOMY

stinghouse Bus Duct



slide aside easily for access to Prestite-insulated plug-in opening. Cover remains on bus duct.

Planned flexibility for the future puts this large manufacturing plant on a fighting basis with the keenest competition. Changes in manufacturing technique or the manufacture of a new product may call for extensive relocation and addition of machinery. Such changes can be met faster... with less work ... with resulting economy if power is carried by a bus duct system.

Westinghouse Bus Duct comes in ten-foot sections and requires only wrench, screw driver and block and tackle for its installation. An exclusive Westinghouse feature is a cantilever hanger which slides to position, making it unnecessary to line up a fixed hanger with a fixed support overhead.

There's a plug-in opening every twelve inches, alternating from side to side. Plug-in openings are insulated with Prestite, which also insulates and supports the busbars. Prestite is an exclusive Westinghouse product ...a wet process porcelain of high dielectric and mechanical strength. Exclusive four-channel housing design makes Westinghouse the strongest of all bus duct construction.

Put your bus duct problems up to Westinghouse Bus Duct Engineers. Call your nearest Westinghouse distributor, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60636

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

BUS DUCT

Ask your Westinghouse Distributor, or write for your copy of Booklet B-3714. It gives you complete information for applying bus duct to your power distribution job.

Darts Don't Deviate

TWO BRONZE SEATS ALWAYS MEET IN A TRUE BALL JOINT

Because their two bronze seats are ground to form a true ball joint, Darts may be closed to a leak-proof connection with the greatest of ease—and may be uncoupled just as easily if needed for other services. Body and nut are made of high-test air-refined malleable iron — practically indestructible. That's why far-sighted buyers prefer Darts. They last longer — cost least in the long run.

Let your Supplier show you Dart's unique construction.

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, R. I.

DART UNIONS

nished by James Leffel & Co., to operate a 750-kva generator of Westinghouse type. Main power transformers will be supplied by General Electric Co.; oil circuit breakers by Allis-Chalmers Mfg. Co.; main control switchboards and switchgear, General Electric Co.; low-tension switchgear and miscellaneous transformers, Westinghouse Electric Corp.; and disconnecting switches and insulators, Bowie Switch Co. It is proposed to complete the project and place station in service late in 1947.

Highway Building Not Curtailed

THE RECENT order further curtailing most types of non-housing construction does not restrict the building of roads, highways, and streets, Claude C. Blair, president of the Paving Brick Institute, stated recently.

"Highway construction has been exempted from this and earlier restrictions because the materials required are not needed for home building and because paving does not take needed labor away from housing," Blair said.

"The supply of road building materials is ample to permit construction to proceed on schedule, and work done in the immediate future will help to provide employment for workers who are unemployed because of the limitations on industrial, commercial, and other building."

17th National Power Show

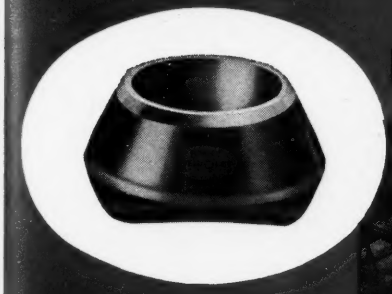
ORGANIZATION OF the 17th National Exposition of Power and Mechanical Engineering, better known as the National Power Show, has been going forward for some time and is now practically completed. The Exposition will return to Grand Central Palace, New York, the week of December 2-7 next, same week as ASME meetings; for the first time since 1940. All the available exhibition space on four floors will be occupied. Over 300 leading manufacturers have already engaged space, and the remaining spaces will undoubtedly be exhausted in the near future.

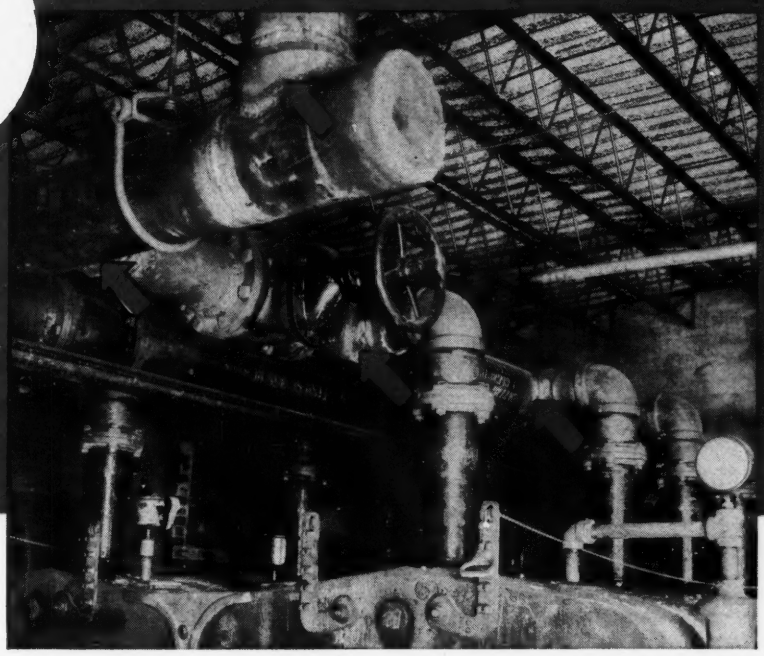
Reconversion of industrial plants everywhere, following four to six years of forced-draft emergency operation, has generated an enormous demand for new power equipment of every description, for both replacement and renewal and in the full range of capacities. The Exposition will cover this general requirement, including units, parts, materials and supplies, with one of the largest displays of its kind in many years, both in space occupied and in number of exhibitors. The showing will consist principally of equipment for the production of power from fuel, power transmission to machines and some phases of power utilization.

Attendance at these expositions, which are normally held every two years is restricted to qualified visitors, classified according to buying influence in the field of power production and use. The Exposition has been designed to provide maximum display and engineering information for these groups. Invitations this year will be based on revised lists, recognizing

How to Simplify

BOILER-HEADER CONSTRUCTION





● Boiler Headers are perhaps the most vital part of any piping system. Adequate strength is necessary because a breakdown here means that the whole system has to be shut down. In addition, maximum efficiency of the system depends to a great extent on full capacity flow into every header take-off. To further complicate matters, take-offs are often close together and working room is usually at a premium.

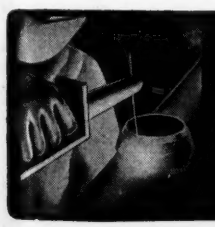
The use of WeldOlet Fittings for making header take-offs will simplify these problems in practically all boiler-header construction jobs.

These fittings are designed so that they provide full original pipe strength at the joint and their funnel-shaped openings insure full flow into the branch lines. They also make it possible to place outlets close together, and require a minimum amount of working room. Only enough space is required to allow room for welding.

To get full specifications and description of these safer, more efficient, easier-to-install fittings, write today for the new 16-page WeldOlet Fittings Catalog.

Forged Fittings Division **BONNEY FORGE & TOOL WORKS • 639 N. Meadow St., Allentown, Pa.**

BUY MORE BONDS AND KEEP THEM



WELDOLETS

TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES

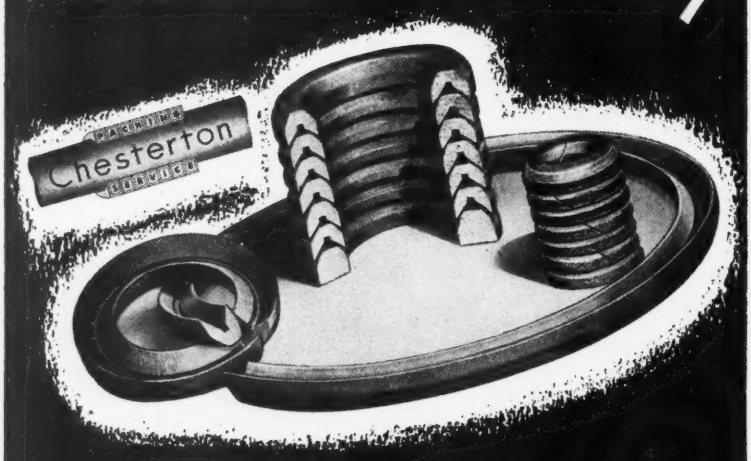
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET

For Welded Branch Pipe Outlets

Drop Plant Maintenance Costs with

CHESTERTON

Parachute Packing



It will pay you to specify CHESTERTON PARACHUTE PACKING on your hydraulic rams, high pressure engines and pumps, hot or cold oils, rubber solvents. . . . It is fully automatic, needs no bothersome after-adjustments, holds a tight seal, brings a sharp drop in plant maintenance costs. . . . Sold in all principal cities by Factory-Trained Distributors. Write for the special engineering folder on CHESTERTON PARACHUTE PACKING.

A. W. CHESTERTON CO.

64 INDIA ST., BOSTON 10, MASS.

Distributors in Principal Cities

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

thousands of dislocations resulting from the war and to the incidence of new industrial projects, especially the numerous smaller specialty manufacturers who are mobilizing at the present time.

Toledo Edison's Coal

THE TOLEDO EDISON CO. has started installation of machinery to be used in a $700,000 coal-handling system for its Acme power plant, it was announced recently.

The new system will replace a coal-handling arrangement designed when the Acme plant's capacity was only 50,000 kw and which had been geared up to handle the 200,000-kw wartime load of the plant. When the new project is in operation, probably by next fall, it will have a coal-handling capacity of 600 tons an hour, making possible processing and storage of a 24-hr coal supply during a normal day shift, he reported.

Coal cars will be placed in position over a series of hoppers, then inverted by the cardumper. From the hoppers the coal will be moved by belt conveyor to the breaker house for crushing and sorting, then another conveyor will transfer it to the silos, he said. A third conveyor will move it into the bunkers of the plant where it will be processed for burning.

Standards Back to Private Industry

REVERSING the wartime trend, Mr. Wallace, Secretary of Commerce, proposes to return to private enterprise the important function of determining industrial and consumer standards.

In a letter to Charles E. Wilson, president of the General Electric Co., and chairman of the Policy Committee on Standards, appointed by the Secretary of Commerce in January, 1945, Mr. Wallace characterized the negotiation and publication of standards through private initiative and on a wholly voluntary basis as "eminently desirable."

In the three-way correspondence between the Department, the Policy Committee, and the ASA, the Policy Committee has given assurance that industry will make possible the necessary extensions of the facilities of the ASA to enable it to render all desired services; and the ASA has informed Secretary Wallace and the Policy Committee of its acceptance of the responsibility.

Mr. Bryans announced a number of steps taken in strengthening the ASA along the lines of the Policy Committee's recommendations. Through a change in its constitution, the ASA has broadened the scope of its work so that it may deal with any standards or standardization project deserving national recognition, whether in the field of engineering, consumer goods, or in other fields.

James Rowland Cudworth has been appointed Dean of the College of Engineering according to an announcement received recently from the President of the University of Alabama.

DISSOLVED OR ENTRAINED AIR

in circulating water—one of many factors governing condenser tube and heat exchanger tube performance—is presented in this discussion by Scovill engineers on selection of the proper tube alloy.

Fast-flowing rivers, rapidly changing tides, spray ponds and moving ships all create a condition causing entrainment of air. Furthermore, all raw water is saturated with dissolved air. Approximately 2.7 cu. ft. of air will dissolve in 1000 gal. of water — the quantity of air to saturate being dependent on the water pressure, composition and temperature. Any low-pressure areas in the circulating system permit the liberation of part of this dissolved air to ally itself with any free air in its erosive-corrosive attack on the tubes.

In actual operating conditions, where dissolved or entrained air in the circulating water is only one of the variables, tube life depends on the nature and/or extent of such other factors as: Velocity and turbulence of coolant . . . Chemical composition of circulating water . . . Temperatures inside and outside of tubes . . . Chemical or electro-chemical actions . . . Marine growths or other deposits . . . Sewage and wastes present . . . Development of protective film . . . Media surrounding tubes.

One of the principal objects of Condenser Tube Technical Research has been the development of alloys designed to give the user longest tube life and most trouble-free service. Where the major factor affecting tube life is the presence of dissolved or entrained air, satisfactory alloys include Cupro-Nickel, Aluminum Brass and Phosphorized Admiralty, each within its temperature limitations.

So many variables surround any condenser or heat exchanger tube application that each case must be treated as an individual problem.

Data accumulated during Scovill's continuous study of condenser and heat exchanger tube service conditions for every known application equip its Technical Service Department to offer sound guidance in tube alloy selection for existing or proposed installations.

THREE SCOVILL SERVICES

Scovill's *Service in Men* offers experienced engineering to help solve your tube selection and installation problems. *Service in Metals* develops and produces Scovill tube alloys that conform to your requirements. *Service in Manuals* consists of literature which gives you latest, authentic information on condenser and heat exchanger tubes. For a free copy of Condenser Tube Booklet, address Scovill Manufacturing Co., 17 Mill St., Waterbury 91, Conn. *Export Dept.* 405 Lexington Ave., New York 17, N. Y.

SCOVILL

SCOVILL

CONDENSER TUBES

One Product • Three Services

Service in Manuals • Service in Metals • Service in Men

MANUFACTURERS' *Personals*

B. J. Cross to Manage CE Co. Research

Bertram J. Cross has been designated to take over management of the Development and Research Department of Combustion Engineering Co., succeeding the late Henry Kreisinger with whom he had been closely associated for over 25 years.

A graduate of Colorado College in 1913, Mr. Cross spent the next few years in mining operations in the West, and in 1917 joined the staff of the U. S. Bureau of Mines where he engaged in fuels research. He came to Combustion Engineering Co. in 1929 and was identified with the early applications of pulverized coal to power boilers, notably those at Oneida Street and Lakeside Stations, Milwaukee. With the exception of 2½ years spent away from the Company in the early thirties, he has given his entire time to research and development, involving field work in testing, temperature measurements, boiler water studies and fuel-burning problems.

Mr. Cross is a member of several important committees of the ASME including Boiler Feedwater Studies, the Boiler Test Code and Fuels, and has been the author of numerous papers before that society and other engineering bodies.

RODA
High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON
High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA
High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER
A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE
Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL
High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER
Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO
Medium volatile, high fusion coking coal for by-product and steam use from Wyoming Co., W. Va., on Vgn. Ry.

Old Kentucky
Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO
Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium
. . . Raven Run

General Coal Company
123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:
BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

Berg Advances at Dravo Corp.

According to an announcement by Dravo Corp., Walter P. Berg has been appointed General Manager of the Machinery Division of the Corporation. Mr. Berg assumes the duties of W. K. Fitch, who recently became Dravo Board Chairman.

Activities under Mr. Berg's supervision will include the furnishing and installing of heavy machinery, heating, power plant construction, and the products of such firms as DeLaval Steam Turbine Co., Cochrane Corp., The Allen-Sherman-Hoff Co., C. H. Wheeler Manufacturing Co., Carrier Corp., Iron Fireman Manufacturing Co., and Tri-Lok Co.

Walter P. Berg graduated from Lehigh University (M E degree) in 1917 and came with Dravo Corp. as an Assistant Engineer in 1923. Since 1938 he has been in charge of the Power Department of Dravo Corp.'s Machinery Division.

Link-Belt Personnel Changes

Link-Belt Co. announces that at a special meeting of the Board of Directors held in Chicago arrangements were made for George P. Torrence to again become associated with Link-Belt Company.

Mr. Torrence will rejoin the Link-Belt organization on July 1, 1946, as Executive Vice-President, and will become President of Link-Belt Co. November 1, 1946, at which time Mr. Carter retires as President, in accordance with the company's retirement plan.

The Board created an Executive Committee consisting of directors Howard Coonley, Russell Livermore and W. C. Carter with Mr. Carter as Chairman.

Rolph to Head Holophane Company

THOMAS W. ROLPH recently was elected president of the Holophane Co., Inc. Mr. Rolph assumes his new duties July 1 and will be located at the company's headquarters in New York City. He succeeds Charles Franck, who has been the general manager close to thirty years and the president during the last 16 years and who will act as chairman of the board after June 30.

Mr. Rolph's advance in the Holophane organization has been steady. He has served the organization for 25 years, first as head of the street lighting department, then Chief Engineer. Several years ago he was made vice president and was placed in charge of manufacturing and engineering. A year ago he was elected to the board of directors.

Globe Steel Personnel Changes

GLOBE STEEL TUBES Co., Milwaukee, announces that Gilbert H. Krohn has been appointed Manager of Sales of Detroit district sales office. For sev-

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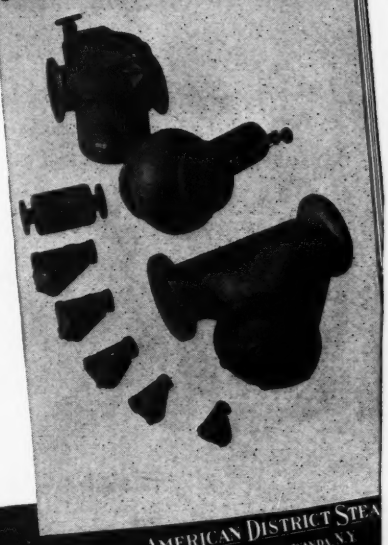

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

New **STRAINER & SEPARATOR CATALOG**

Complete working data on ADSCO Strainers and Separators is given in this new illustrated catalog. Every man concerned with distribution and utilization of steam, liquids and gases will find it a helpful working tool. Write for your personal copy—ask for Bulletin 46-50-E.

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

ADSCO

eral years he has been Assistant District Sales Manager for the company's office in Chicago. Mr. Krohn succeeds Arthur A. Loeffler, who is retiring after more than 25 years of service with the Globe Steel Tubes Co.

Willard C. Christianson, whose title has been Assistant to Vice President in Charge of Sales at the general sales office in Milwaukee, has been transferred to the Chicago district sales office.

Frederick K. Krell has been appointed Sales Service Supervisor to succeed Willard C. Christianson.

Anderson Returns to Bacharach

COL. A. H. ANDERSON who, before he left for duty with the U. S. Army, had been with the Bacharach Industrial Instrument Co. since 1923, has returned to the company in the capacity of Manager of the Heating Division and as treasurer and a member of the Board of Directors. Because of the entry of the company into instrumentation for the refrigeration and air conditioning trades, and its expanded activities in the heating field, he will devote his entire time to the management of this division.

Appointment of Herbert H. Roosa as sales manager of Manzel Brothers Co., Buffalo, was announced recently.

H. L. Beohner and A. D. Way have been appointed Technical Manager and Chief Mechanical Engineer respectively of The Permutit Co., it was announced recently. In his new capacity, Mr. Beohner will be responsible for the company's technical policy on the application, guarantee and performance of its products which include zeolites, ion exchangers, deaerators, chemical feeds, de-gasifiers and precipitation equipment. He will also serve as chairman of the Engineering Committee. Mr. Way, as Chief Mechanical Engineer, will administer the Engineering Department and supervise the mechanical design and layout of equipment.

Howard J. Mullin is appointed manager of sales, St. Louis district, Carnegie-Illinois Steel Corp., succeeding Robert J. Korsan, Jr., retired. Mr. Mullin assumes his new duties immediately.

Chester P. Ford, Philadelphia, has been named divisional manager of the mid-western area of the Penflex Sales Co., newly formed sales organization of the Pennsylvania Flexible Metallic Tubing Co., Philadelphia.

The Bury Compressor Co., Erie, Pa., announces the election of B. C. O'Brien as President and General Manager. Mr. O'Brien is a graduate in mechanical engineering, of Rose Polytechnic Institute, and has had wide experience in air compressor manufacture and sales.

The appointment of David M. Salsbury as Executive Vice President of the Westinghouse Electric Supply Co. has been announced. Mr. Salsbury, formerly Vice President and general manager of the Company, succeeds Walter Williamson, who has retired. Mr. Salsbury, a native of Belleville, Ont., has been in the electric supply business since 1915, when he joined the Northern Electric Co. at Calgary, Canada.

F. B. Ennis has been appointed manager of manufacturing of the General Electric Co. Wiring Device Division, according to a recent announcement. Following his appointment, Mr. Ennis, who came to General Electric in 1909 and was most recently superintendent of the Wiring Device Section of the Company's Bridgeport Works, announced the appointment of seven officials in the G-E plants under his jurisdiction.

R. N. Landreth, assistant to the vice-president, General Machinery Division, of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has been named to direct the activities of the company's Washington, D. C., district office in addition to his other special duties, according to a recent announcement. Mr. Landreth, who joined the company in 1931, was transferred to Washington in 1934 and served as district manager there until 1944 when he was named special representative. In September, 1945, he became assistant to the vice-president with offices in Washington.

Westinghouse Electric Corp. has announced the appointment of Harold C. Hickock as Central District manager of the B. F. Sturtevant Co. Division of Westinghouse with headquarters in Pittsburgh, Pa. Mr. Hickok was graduated from Worcester Polytechnic Institute, Worcester, Mass., with a degree of electrical engineer in 1918 and joined Westinghouse immediately.

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without Nessler Tube Standards!

The Taylor Water Analyzer is designed for determining silica in boiler water, pH and ammonia in condensate and copper or chlorine used for control of algae in spray ponds and condensers. It is ideal for determining the pH of practically unbuffered condensate as it eliminates the effect of the indicator. This effect is pronounced with the regular comparator because the ratio of indicator to sample is 1 to 10 or 20. Accurate results can be obtained with the Water Analyzer because the indicator sample ratio is 1 to 150.

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To make a determination, you simply place the treated sample in the middle tube and fill the other two tubes with distilled water. Insert the color standard slide. Look into mirror in base, move slide until the test sample matches one of the color standards. The pH, silica, copper, etc., content may then be read off directly from values engraved on the slide.

Taylor Water Analyzer, complete with any one Slide $18.00

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This chart will tell you about how much money you can save by installing Cochrane Continuous Blow-off and how much money it will cost you

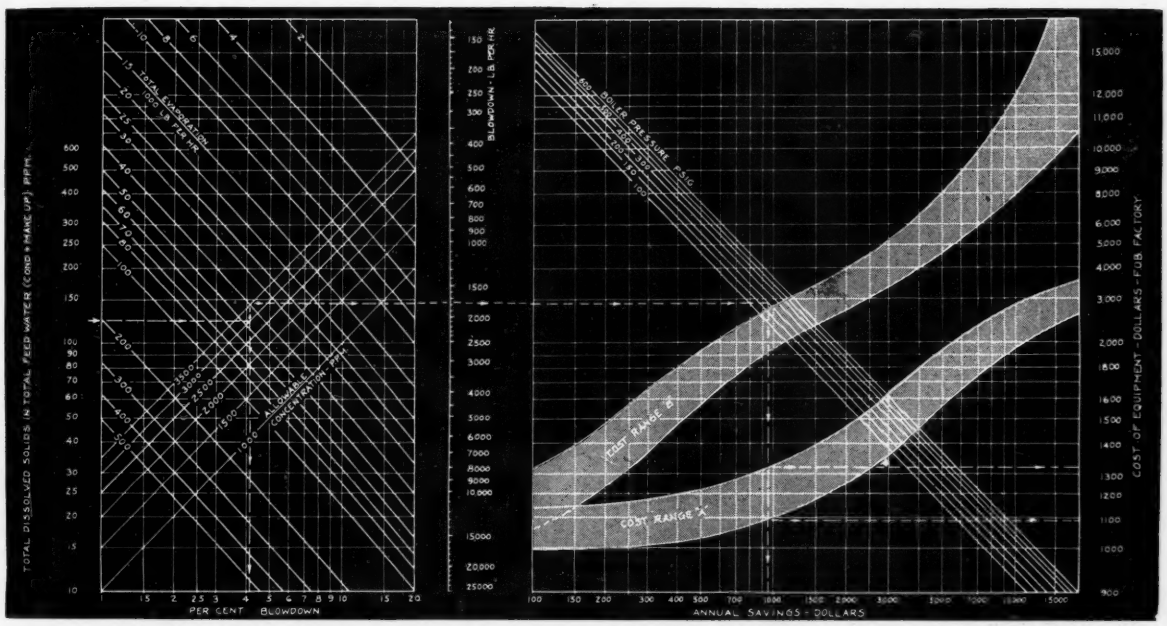

TOTAL DISSOLVED SOLIDS IN TOTAL FEED WATER (COND + MAKE UP) PPM.
PER CENT BLOWDOWN
BLOWDOWN - LB. PER HR.
ALLOWABLE CONCENTRATION PPM
BOILER PRESSURE P.S.I.G.
COST RANGE "B"
COST RANGE "A"
COST OF EQUIPMENT - DOLLARS - FOB FACTORY
ANNUAL SAVINGS - DOLLARS

CHART FOR ESTIMATING SAVINGS BY, AND COST OF COCHRANE CONTINUOUS BLOW-OFF EQUIPMENT

DIRECTIONS: The left hand abscissa is the total value of Total Dissolved Solids (TDS) in the total feedwater to the boiler including make-up and all returns. Its actual value is found by multiplying the TDS in the raw make-up by the per cent of make-up.

Example: Assume—

TDS=125 ppm.
Allowable boiler concentration=3000 ppm.
Total evaporation=40,000 lb. per hr.
Boiler Pressure=200 psig.

Enter chart at the left at 125 ppm. and draw a horizontal line to the 3000 ppm. Allowable Concentration line. Through this point draw a vertical line to the bottom of the chart and read the per cent of blow-down (4.2 approximately). Now extend the vertical line (if necessary) until it intersects the proper Total Evaporation line (40,000 lbs. per hr.) and draw a horizontal line to the right from this point of intersection to the proper Boiler Pressure (200 psig.), reading the total blow-down (1754 lbs. per hr.) where the line intersects the blow-down column. From the intersection of this line with the proper Boiler Pressure line, drop a vertical line to the bottom of the chart and read the approximate Annual Savings ($950) for operation 24 hrs. per day, 300 days per year, with 75 per cent boiler efficiency and 14,000 Btu per lb. coal at $5.00 per ton on the grates. (For values other than these multiply the anuual savings by the appropriate factor, as, for instance, for 12 hr. operation multiply the annual savings by one-half.)

Where this last line intersects the limits of Cost Range "A," draw two horizontal lines to the right-hand edge of the chart and read the approximate Cost of Equipment ($1090 to $1320) for a Class I system.

For total evaporations in excess of those covered by the chart, divide the total evaporation by ten and proceed as before, multiplying the determined blow-down and annual savings values by 10 for final result. When this procedure is followed, Cost Range "B" is to be used directly without multiplying any factor.

COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia 32, Pa.

Further details on Continuous Blow-off and its surprising economies are contained in an article, "Continuous Blow-off for Boiler Plants," by Herman Ebert and Joseph Thompson, a reprint of which will be sent on request.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies

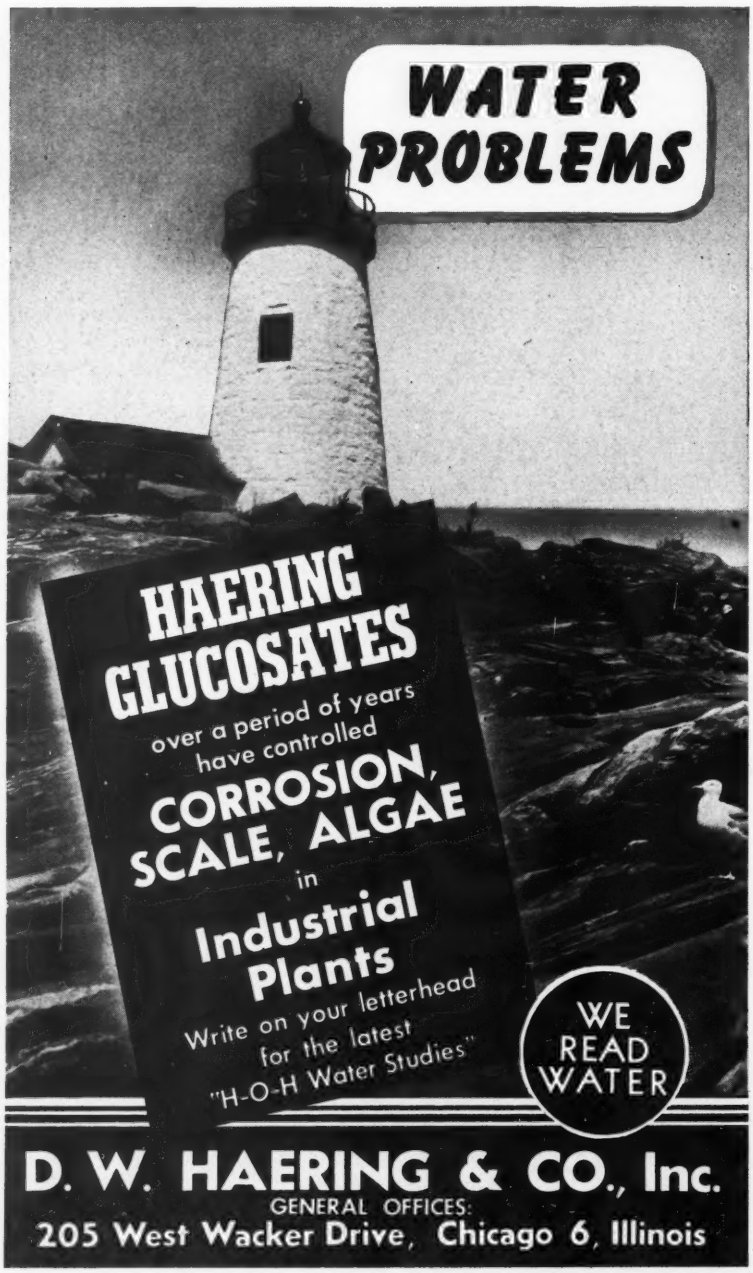
(Continued from page 54)

sheds new light on the baffling problems of noise control. Typical of the chapter headings are: What is Sound? What are Sound Waves? Why are Sounds different? How Can We Measure Sound? What is Sound Level? What is a Decible? What is Resonance? What Does Noise Control Mean? Charts, graphs and sketches help in the understanding of the story. The tabulations at the end of the booklet provide commonly-used data in ready reference form. Burgess-Manning Co.

PRIME MOVERS

51 **Wheel Turbines**—Explanation of 14 advantages; diagrammatic illustrations and explanations of operation; 8 pages. Terry Steam Turbine Co.

52 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.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53 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

54 **Steam Engines**—Bulletin No. 306; Engineering data, tabular material descriptions; 8 pages. Troy Engine & Machine Co.

55 **Generating Sets**—Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

STOKERS

56 **Stoker**—Catalog H; Type H stoker; cross-sectional installation drawing; features of ash discharge; typical installations; 10 pages. American Engineering Co.

57 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 pages. American Engineering Co.

58 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

59 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

60 **Pneumatic Spreader Stoker**—Threefold booklet on the inner page of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

61 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

OIL, GAS BURNERS

62 **Oil Burning Systems**—Bulletin 45-1; three types of systems; drawings, tables of capacities and descriptions; photos; 4 pages. Faber Engineering Co.

63 **Mechanical Oil Burners**—Bulletin 45-2; two systems; drawings, tables of capacities and descriptions of units; parts list; 4 pages. Faber Engineering Co.

64 **Oil and Gas Burners**—Bulletin 45-3; combination burner; photos, drawings, tables; 4 pages. Faber Engineering Co.

65 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

66 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

67 **Gas and Oil Burners for Oil Refinery Furnaces**—Bulletin 702; details of firing with gas, with oil; photos; drawings; 4 pages. Peabody Engineering Corp.

WATER TREATMENT

68 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Co., Inc.

69 **Industrial Water Treatment**—Microbiological Control of and Through Industrial Waters; spot summaries of improvement of process efficiency and product quality by proper sterilization. Wallace & Tiernan Co., Inc.

70 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Co., Inc.

71 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Co., Inc.

72 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

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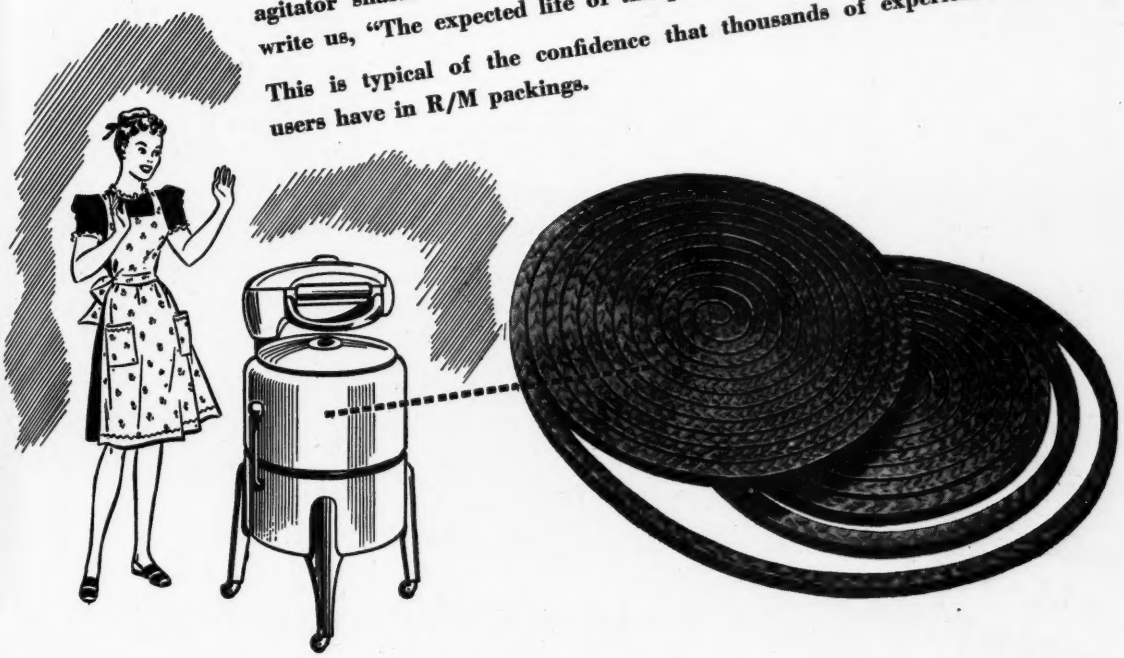

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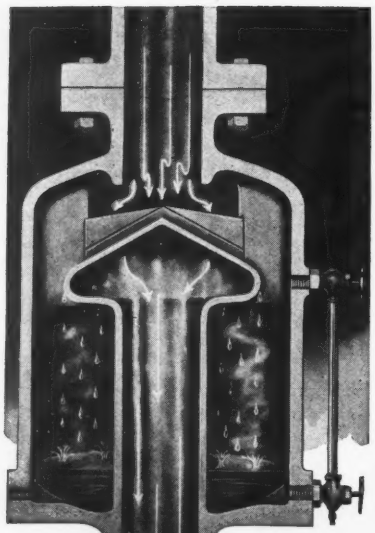

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74 **Boiler Feedwater Q & A—Bulletin 30;** 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

75 **Water Analysis—Bulletin 6A;** standard methods of water analysis and interpretation of results; 4 pages. National Aluminate Corp.

76 **Water Treatment—Scale and corrosion** control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

77 **Algae and Slime—Bulletin 31;** the elimination of algae and slime in cooling systems, paper mills, etc., drawings, photos; 4 pages. National Aluminate Corp.

78 **Chemical Feeding and Proportioning** —Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

79 **Water Treatment**—Various types of water treating; corrosion, carry-over; boiler scale; flexibility; rust prevention; brine treatment; softening and coagulation; cooling and condenser water; chart of treatment in various industries; 24 pages. Western Chemical Co.

80 **Water and Steam Treatment**—Two bulletins on Algaecide and Coravol; when and where algaecide should be used; tells how Coravol operates in the steam system; features and advantages; testimonials; 9 pages total. Western Chemical Co.

81 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

POWER TRANSMISSION

82 **Speed Reduction, Increase Gear—Bulletin S130**—description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

VALVES

83 **Regulating Valves—Bulletin 1-A;** valve data book; description, dimensions and lists of parts; typical installations; rated capacities; prices; 52 pages. Atlas Valve Co.

84 **Pressure Regulator—Bulletin 1-B;** description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

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87 **Pressure Reducing Valves—Bulletin 401-A;** selection of proper valve; construction; installation; capacity tables; interchangeability; dimension tables; 14 pages. Leslie Co.

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89 **Valves—Bulletin E-100;** for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size, shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

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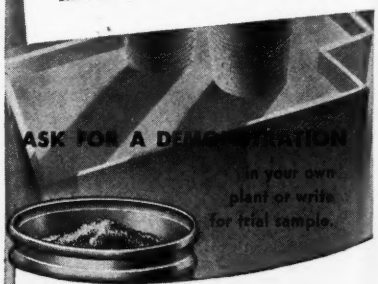

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"As near as we can tell from rough check, we are saving approximately 125 tons of coal per month since this unit was put in operation."

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92 **Lubrication Recommendations**—Special oils for diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

93 **Cutting Fluids**—Facts about cutting fluids: machine tool operations; fundamentals of cutting; How to Apply; metallic cutting tools; tabular material; shop practices; 50 pages. Standard Oil of California.

94 **Diesel Operation**—Relation of fuels and lubricants to the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleaniness; tabular material, charts, formulas; 114 pages. The Texas Co.

95 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

96 **Drop Forged Flanges**—Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

CONTROLS, METERS

97 **Pressure Controllers**—Bulletin 402; air, gas, steam or water service; when to use; selecting diaphragm regulating valve; sizing and capacity; operation; installation; ordering; specifying; dimensions; diaphragm regulating valves; 12 pages. Leslie Co.

98 **Pump Governors**—Bulletin 403-A; reciprocating, turbine-driven, motor-driven pumps; selection of governor; construction; pressure, capacity tables; installation; sizing; specifying; dimensions; 12 pages. Leslie Co.

99 **Temperature Regulators**—Bulletin 404-A; heating or cooling service; selection of regulator; temperature and pressure ranges; installation; various types described and pictured; ordering and specifying; complete tabular material; 16 pages. Leslie Co.

100 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

101 **Pump Governors**—Bulletin 2-B; photos, descriptions, list prices, dimensions and weights in tables; operation and adjustment; installation drawings; 20 pages. Atlas Valve Co.

102 **Engineering Monographs**—Series of eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

103 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc.; 20 pages. The Hays Corp.

104 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells; where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

105 **Pointer Gages**—Bulletin 45-580; where and how to install pointer gages; engineering data, drawings; 8 pages. The Hays Corp.

CLASSIFIED ADVERTISING

HELP WANTED

PROJECT ENGINEER

Graduate B.S.M.E. needed by midwest utility company. Must have experience in power plant engineering and design work in connection with steam engineering and mechanical problems. Position necessitates man having ability to secure data on assigned project requirement, design project to meet needs and follow through to completion. Please forward resume of educational background, experience, salary expected and enclose a recent photograph.

APPLY BOX 1515
POWER PLANT ENGINEERING
53 West Jackson Blvd., Chicago 4, Ill.

POSITION WANTED

Competent and conscientious Engineer desires position as STEAM POWER PLANT SUPERINTENDENT or equivalent. Age 43. Two years Technical College. Over 20 years diversified experience mostly supervisory capacity on Efficient Operation, Maintenance and Overhaul of modern steam installations from low to 1400 lb pressure. Powdered Coal, Gas, Oil and Stoker fired, together with all auxiliaries. Desire change after lengthy service with present employer. Available on reasonable notice. Address Box 1514, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

SALESMEN AND AGENCIES

SALES ENGINEERS!

With mechanical or chemical engineering background. Excellent opportunity for hard workers with real sales ability in key locations all over the United States. We are well known manufacturers of nationally advertised chemicals for the scientific conditioning of industrial water—car essential; experience in this line unnecessary—our organization knows about this advertisement. Write fully age, education, sales experience, salary requirements.

BOX 1519
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DIVISIONAL SALES MANAGER

Desired by nationally known manufacturer of electrical and mechanical control equipment for industrial applications. Technical sales background required. Salary plus commission. In reply give full details.

BOX 1512
POWER PLANT ENGINEERING
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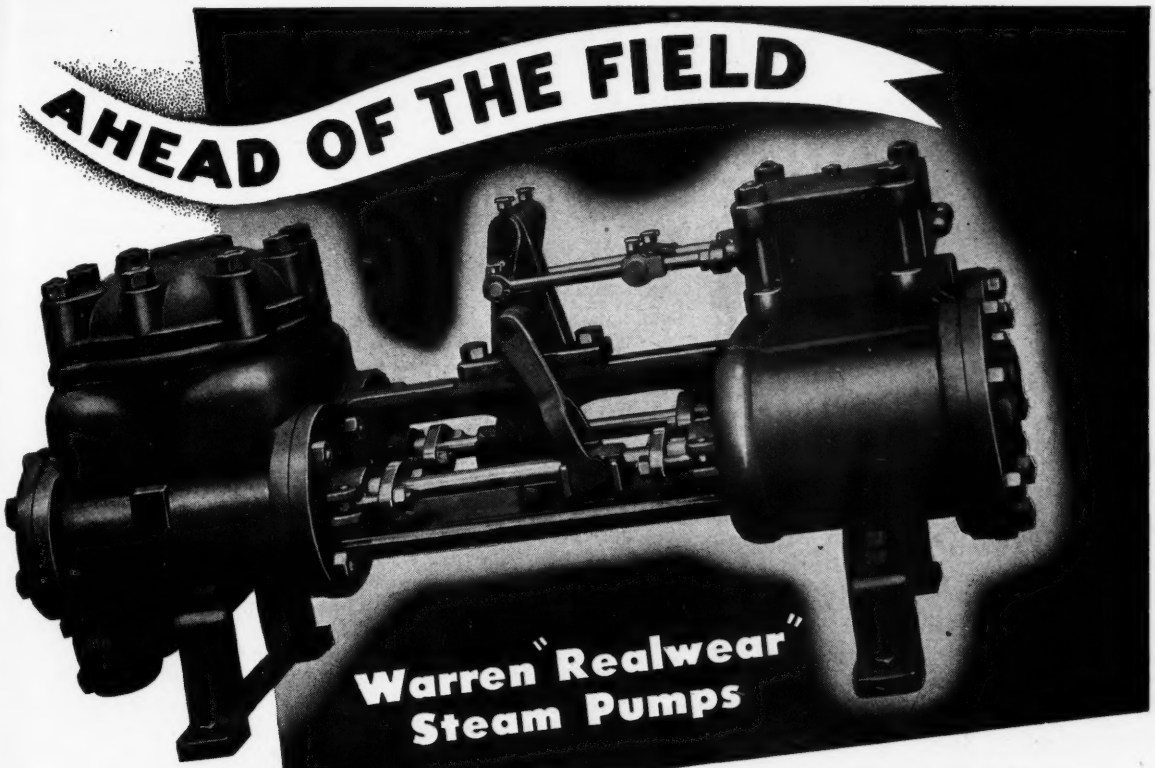
Chicago 4, Illinois

SALES MANAGER

with mechanical or chemical engineering background. Must have proven record in sales management and must be capable of building up an aggressive sales organization in the Chicago territory. We are well known manufacturers of chemicals for the scientific conditioning of industrial water. Write fully education, experience, salary requirements. Box 1518, Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Illinois.

Classified Advertising Continued on page 174

AHEAD OF THE FIELD



Warren "Realwear" Steam Pumps

WARREN MOLDED PISTON CUP PACKING

THE DURABLA VALVE

Completely open under full load

Partially open under light load

4 new standard features at no extra cost!

Yes, Molded Piston Cup Packing, Stainless Steel Durabla Valves, Stainless Steel Piston Rods and All Steel Valve Gear (Bronze Bushed), are now *standard* features on Warren Horizontal Duplex Piston Pumps—"Realwear" Type! Standardization of these features . . . in addition to the many other advantages of "Realwear" design . . . gives you a pump that is far and away the leader in its field. Here are the advantages:

WARREN MOLDED PISTON CUP PACKING

Greater efficiency and lower operating costs because of minimum slippage . . . and longer liner life because of less wear when these cups are used.

Repacking made easier.

Much longer life of cups compared to ring packing.

Successfully handles practically all liquids . . . including hot water to 250° maximum at pressures to 1000 lbs. maximum . . . with standard cups and higher temperatures and pressures with special cups.

STAINLESS STEEL DURABLA VALVES

Achieve instant adjustment to variations in load; open only enough to allow passage of the flow; close instantly; eliminate slip; reduce cavitation, turbulence, and friction losses to a minimum; and permit pumps to operate at full load at slower speeds.

STAINLESS STEEL PISTON RODS

Insure maximum resistance to corrosion and wear.

ALL-STEEL VALVE GEAR (Bronze Bushed)

Adds strength and length of life to this constantly moving and important part of the pump.

Write for information

WARREN PUMPS

WARREN STEAM PUMP COMPANY, Inc., Warren, Mass.

Low-Cost Maintenance for Lube Oil Coolers

When you clean clogged lube oil coolers the more effective Oakite way, with plant-tested methods and materials that successfully expedite the work, you will find that lime-scale, rust, carbonized oil, or other insulating deposits are thoroughly, quickly, safely removed.

Merely permit to "soak" or circulate the recommended Oakite solution through the water side or oil side of the cooler as directed. Then rinse. Inspection will reveal that all accumulations have been completely removed and normal heat transfer efficiency fully restored. Time is saved, units are returned to service without delay, and maintenance costs reduced to a minimum.

WRITE FOR FREE MANUAL

It gives tips on low-cost cleaning of lube oil coolers, pre-heaters, jacket water coolers, feedwater heaters, evaporators, transformers and other maintenance jobs.

OAKITE PRODUCTS, INC.
18C Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE

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107 **Flue Gas Analyzer**—Bulletin 45-668; principle of operation; construction features; technique; models and prices; Burettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

108 **Combustion Testing**—Bulletin 46-497; making combustion simple; how to run an orsat—pictures and directions; making draft survey; flue gas temperature; charts and drawings; 12 pages. The Hays Corp.

109 **Temperature Regulators**—Bulletin 7-A; six types; descriptions, list prices, tabular material, photos; lists of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

110 **Feed Water Regulator**—Bulletin 8-A; description of operation; cycle of operation; full-page installation drawings; instructions for installing regulators; list prices and parts lists; 14 pages. Atlas Valve Co.

111 **Temperature Regulators**—Bulletin 6-A; for hot water heaters, storage tanks, etc.; what they do; operation; regulation; descriptions and drawings; list prices; applications; dimensioned drawings; installations; 20 pages. Atlas Valve Co.

112 **Recording Flow Meter**—Bulletin 350A; what it does, features, chart of rated capacity; construction and operation; installation drawings, tables of capacity; photos; 8 pages. Builders-Providence, Inc.

113 **Propeller-Type Meter**—Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

114 **Feedwater Textbook** — "Mechanical Feedwater Regulation for Boilers" by Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages.—Northern Equipment Co.

PACKING

115 **Packings, Gaskets**—Full-page descriptions of each type of packing, plunger rings, pump valves, sheet packing, gaskets; installation and maintenance; engineering data and tables, conversions and equivalents; complete indexing; 64 pages, board cover. Sea-Ro Packing Co.

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117 **Packings**—Bulletins P3, P14, P25 and P22; descriptions, tables of size and size no.; tables of service for various packings; prices; 18 pages total. Greene, Tweed & Co.

FITTINGS

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REPRESENTATIVE AVAILABLE—Northern Illinois and Wisconsin. Professional Engineer well acquainted with leading power plants in this territory wants one or two additional high-grade lines. Box 1516, Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Illinois.

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And Keep the Bonds You Have

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Corrosion-Resistant Alloys Increase Efficiency, Cut Maintenance Costs

Although the principal use for tubing in power plants for land stations and ships is in surface condensers there are, of course, many other applications, such as oil coolers, hydrogen coolers, boiler feedwater heaters, jet condensers and other vital equipment, where corrosion-resistant tube alloys are required. Unsatisfactory performance of such tubing can seriously affect operation of the entire plant by interrupting the smooth flow of service and increasing maintenance and replacement costs.

Importance of Alloy Selection

Every power plant engineer realizes the necessity for keeping expenses down, particularly in view of the fact that manpower and materials cost so much more these days. They realize the necessity for greater efficiency to help offset higher costs, and recognize the importance of modern tube alloys, developed in recent years to withstand more severe operating conditions. Although in some cases the first cost may be higher, the added service life and lower maintenance make such tubing more economical in the long run. It will, therefore pay power plant engineers to give the most careful consideration to metal specifications involving engineering requirements. Since water and operating conditions are subject to change with the passage of time, experience has shown that the use of the same tube alloy, which may have been satisfactory before does not always work out. By doing a little spade work in the form of installing several test lots of tubing made from different alloys it is possible to determine more accurately which alloy will best serve existing conditions.

Listed herewith are a number of applications for copper-base alloy tubing in power plants, with the alloys most generally used. Operating conditions, equipment design, nature of the gas or liquid handled and other factors must be taken into consideration.

Wide Range of Alloys Available

Each year Bridgeport supplies to customers many millions of pounds of corrosion-resistant tubing which is subjected to a wide range of operating conditions. For clean fresh water Arsenical Muntz Metal, Red Brass and Arsenical Copper are giving fine service. For good general corrosion resistance to low velocity sea water, Arsenical Admiralty is frequently recommended. Where sea water has particularly high velocity (over 7 ft. per second) which causes ordinary alloys to fail from impingement corrosion Aluminum Brass is giving very satisfactory service. 70/30 Cupro Nickel is recommended for rapidly flowing sea water, and has the ability to function satisfactorily at higher operating temperatures. The U. S. Navy specifies 70/30 Cupro Nickel for war ships and other vessels.

Bridgeport's Duronze IV (arsenical aluminum bronze) is one of the finest tubing alloys made. It has stood up well under such difficult conditions as harbor water polluted by sewage and factory wastes and in tidal estuaries where salt water is mixed with polluted fresh water. Duronze IV also has fine resistance to impingement corrosion.

Bridgeport's Duplex Tubing

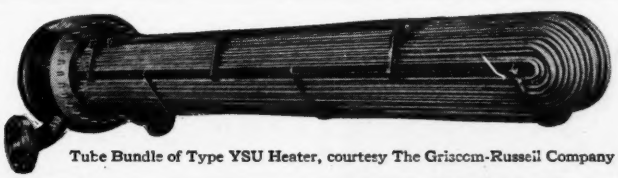
Where corrosion is too severe for a single metal or alloy—simultaneous attack on the inside and outside by different corrosive elements—engineers should consider Bridgeport's Duplex Tubing. It is available in combinations such as copper-base alloys with low carbon steel, stainless, monel, aluminum or nickel. Bridgeport's Duplex Tubing is solving many severe double corrosion problems. For example, it is being used successfully in ammonia refrigeration equipment with steel to the ammonia side and a copper-base alloy to the water.

Technical Service Department

To determine the condition and life expectancy of your condenser and heat exchanger tubes our laboratory will gladly work with you. Care in sampling, however, is important and this matter should be taken up with us before sample tubes are removed. To help in the selection of the most suitable tube alloy we also offer the services of our Technical Service Department, composed of laboratory-trained men. In the meantime write for Bridgeport's 112-page Condenser Tube Manual.

Applications For Copper-Base Alloy Tubing in Power Plants

- Air Cooled Heat Exchangers (Copper Fins on Admiralty or Copper)
- Auxiliary Steam Evaporators (Admiralty)
- Boiler Blowdown Heat Exchangers (Admiralty, Muntz Metal or Cupro Nickel)
- Boiler Feed Make-Up Water Evaporators (Admiralty or Cupro Nickel)
- Compressed Air Coolers (Admiralty, Copper or Red Brass)
- Compressed Air Lines (Copper)
- Condensate Coolers (Admiralty, Muntz Metal or Copper)
- Diesel Lubricating Oil Coolers (Admiralty, Muntz Metal or Copper)
- Diesel Jacket Water Coolers (Admiralty, Muntz Metal or Copper)
- Economizers (Admiralty)
- Evaporators (Admiralty, Copper, Muntz Metal or Red Brass)
- Evaporator Condensers (Admiralty, Aluminum Brass, Duronze IV or 70/30 Cupro Nickel)
- Exhaust Gas Water Heaters (Admiralty or Aluminum Brass)
- Feed Water Heaters (Admiralty, Copper or Muntz Metal)
- Fuel Oil Heaters (Copper or Admiralty)
- Fuel Oil Lines (Copper, Admiralty or Red Brass)
- Generator Air Coolers (Admiralty or 70/30 Cupro Nickel)
- Gland Steam Condensers (Admiralty, Muntz Metal or Copper)
- Hydraulic Pressure Lines (Copper or Duronze V)
- Hydrogen Coolers (Admiralty or 70/30 Cupro Nickel)
- Instrument Tubing (Copper or Duronze V)
- Intercoolers and Aftercoolers (Admiralty)
- Lubricating Oil Coolers (Admiralty, Muntz Metal, Red Brass or Copper)
- Refrigeration or Cooling Equipment (Admiralty, Copper or Duplex Tubes) made up of a copper-base alloy and steel.
- Steam Condensers (Main or Auxiliary) (Admiralty, Aluminum Brass, Muntz Metal, Duronze IV, Copper or 70/30 Cupro Nickel)
- Tank Suction Oil Heaters (Copper, Admiralty or Muntz Metal)
- Turbine Oil Coolers (Admiralty, Muntz Metal, Aluminum Brass, Duronze IV or 70/30 Cupro Nickel)
- Unit Heaters and Coolers (Copper or Admiralty)
- Vent Condensers (Admiralty, Red Brass or Muntz Metal)
- Water Heaters (Copper, Admiralty or Red Brass)
- Waste Water Heat Exchangers (Copper, Admiralty, Muntz Metal or Red Brass)
- Water Lines (Copper, Red Brass or Muntz Metal)



Tube Bundle of Type YSU Heater, courtesy The Griscom-Russell Company

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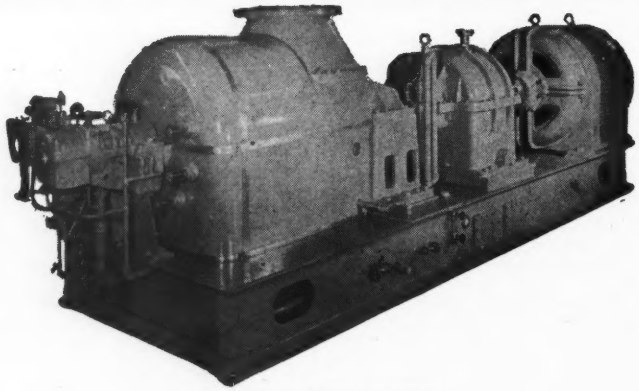
MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

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Mechanical drive turbines, horizontal and vertical
Reduction Gears Steam Boilers

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

TEMPLETON RETURN STEAM TRAPS

for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

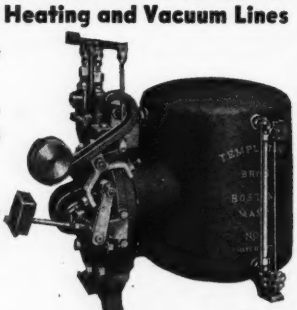
Pumps Water at any temperature or pressure.

Open float cannot burst or waterlog.

Valves and Seat Bronze or Stainless Steel.

Sizes 1 in. to 4 in. inlet and outlet.

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



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PUMPS

125 Horizontal Duplex Piston Pumps—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions drawings, tables; 4 pages. Warren Steam Pump Co., Inc.

126 Centrifugal Pumps — Bulletin 302-30 Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump, Co., Inc.

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129 Controllable Capacity Pumps — Data Book 65; description, general design, method of operation; automatic control of pump delivery; drawings; adaptations, applications, power cost tables; standard sizes and ratings; 8 pages. The Aldrich Pump Co.

130 Hydraulic Pump Handbook—Bulletin 50; hydraulic information and tables; electrical data; capacities of pumps, cylinders; friction losses; pipe and fitting data; ram speeds and flows; discharge of nozzles; water required for boilers; capacity of shafts; various equivalents; pump discharge diagrams; conversion factors, steam tables; materials for pumping various liquids; pump plunger loads; etc.; products; facilities; 62 pages. The Aldrich Pump Co.

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132 Centrifugal Pumps — Bulletins 225-1, 227-1, 236, 228-1, 229-1; specifications, composite dimension tables; sectional views, rating tables, charts; total 28 pages. Warren Steam Pump Co., Inc.

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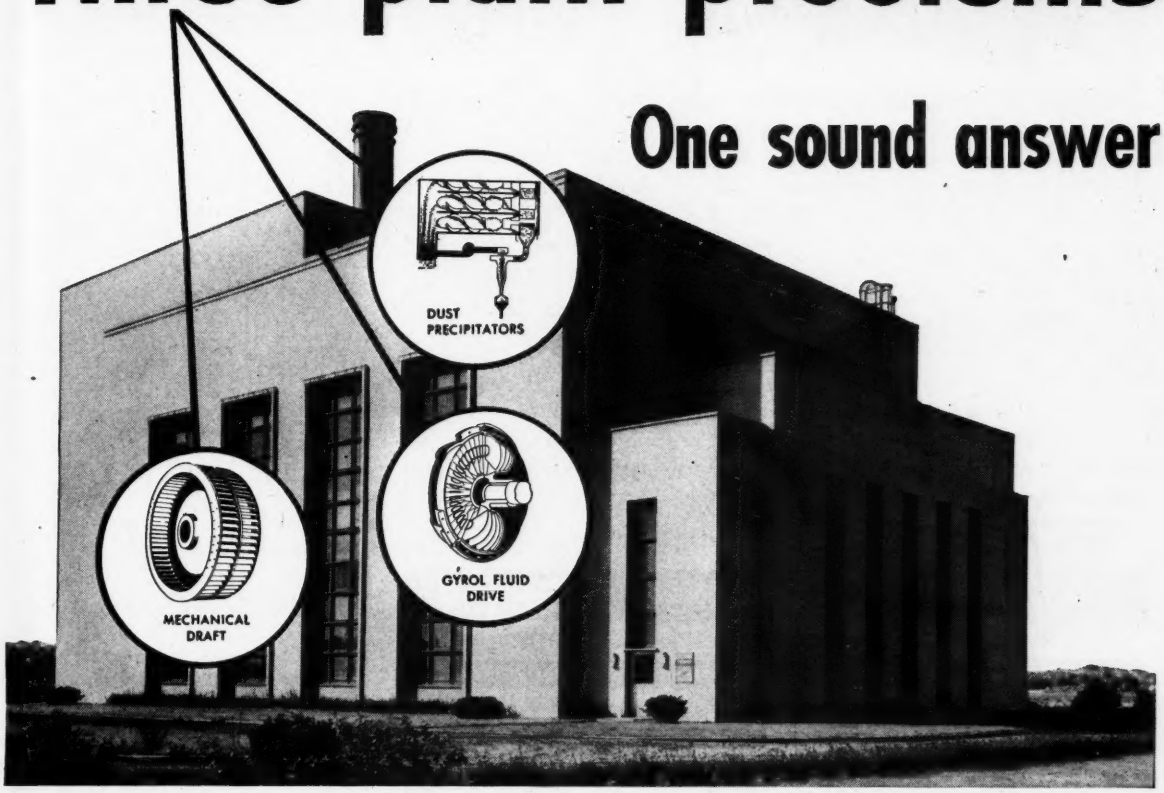

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Under gruelling wartime operating conditions, American Blower Mechanical Draft Fans, Dust Precipitators and Gyrol Fluid Drives have proved their merit in power plant operation.

As a result, the word is going round: "Buy all 3 from ABC for better overall power plant efficiency." Naturally, we take pardonable pride in the performance record of these products—both before and during the war years.

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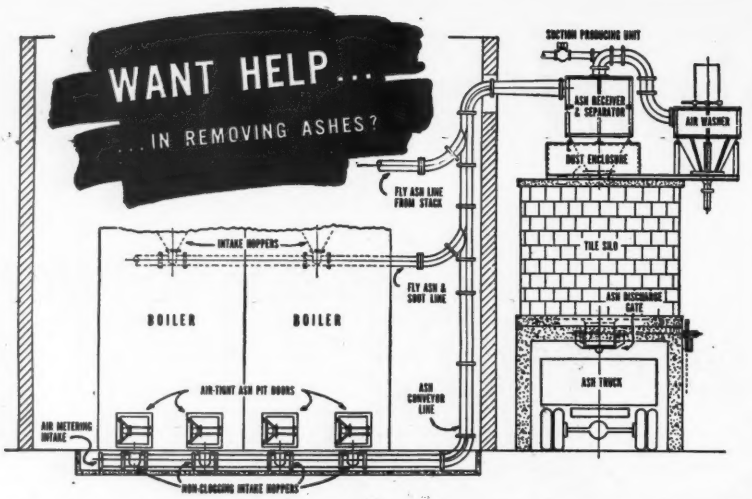

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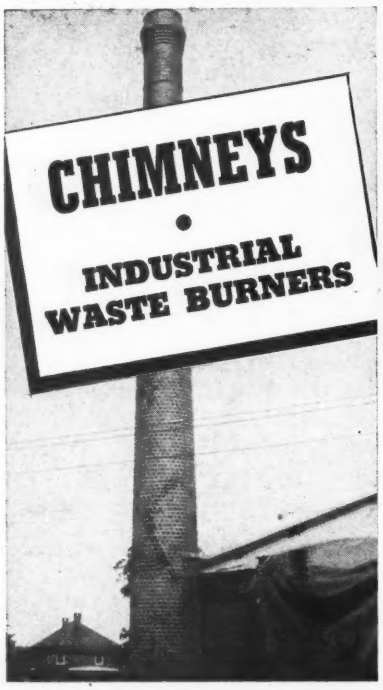
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS



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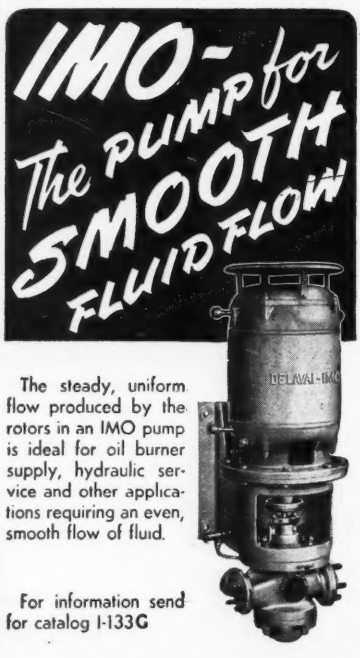

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MISCELLANEOUS

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148 **Fluid Handling Equipment**—Catalog 45; for industrial, power plant, process industries; descriptions, tables on strainers, valve control boxes, check valves, safety vents, foot valves, backwater sewer valves, interceptors, intercepting drains and traps, solids interceptors, lint interceptors, floor and area drains, etc.; completely illustrated; 12 pages. J. A. Zurn Mfg. Co.

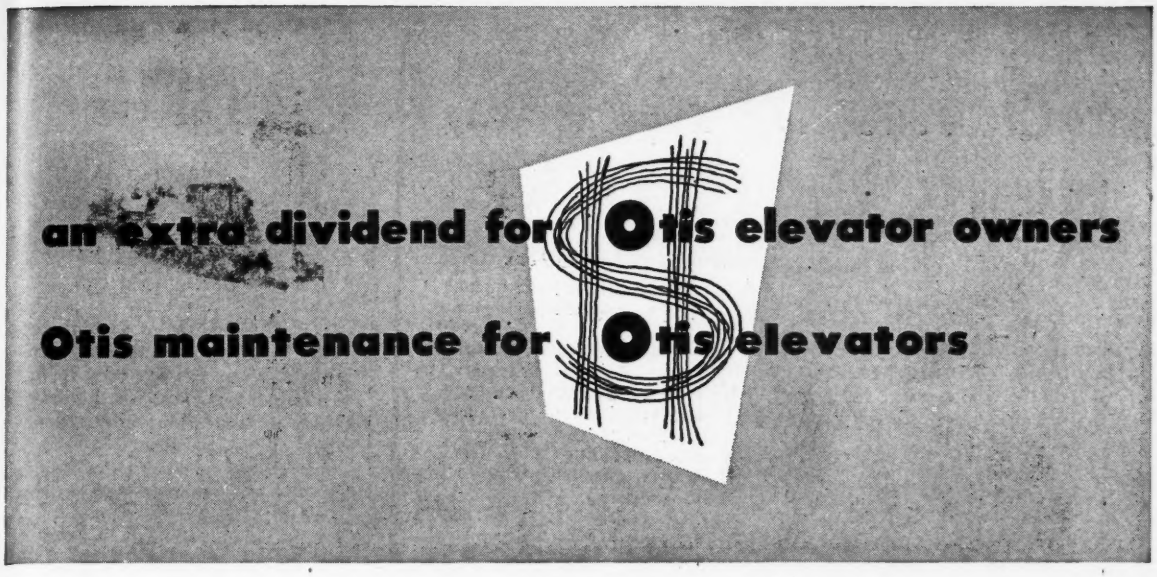
New Hydro Plant in Shoshone Canyon

THE BUREAU OF RECLAMATION will construct a 5000-kw hydroelectric plant on the Shoshone Irrigation Project as soon as funds are available. The plant, known as the Heart Mountain Power Development, will be built at an estimated cost of $900,000 near the outlet of the Shoshone Canyon Conduit, about three miles downstream from the Shoshone Dam. This dam was constructed by the Bureau to store water for the irrigation of fertile project lands.

It is reported that additional generating facilities are urgently needed in view of the critical power shortage which now exists in northern Wyoming. The area, well-known for its agriculture production on irrigated lands, is becoming an oil-producing center of increasing importance and rapid expansion of drilling activities has greatly increased demands on the already inadequate power supply.

The immediate need for more power is due to the discovery of a new oil field in the Elk Basin area, north of the Shoshone Project. Various drilling companies are also operating in the vicinities of Meeteetse and Gebo, Wyoming.

To fulfill requirements of the Flood Control Act of 1944 the Heart Mountain Power Development report was transmitted to the Secretary of War and to the Governor of Wyoming for their review. Copies of the report were also reviewed by the Federal Power Commission, the Department of Agriculture, and the Corps of Engineers. The Governor of Wyoming and these agencies concurred in the proposed plan of development.



Otis Maintenance service is provided so quietly and with so little trouble to Otis elevator owners that many do not realize its true value to building management. ● Although it may not appear on the balance sheet, the value of this service may be measured in tenant satisfaction, more sales made or more freight moved, or in freedom from elevator care. It is especially valuable because of the spirit of the two thousand people who make up the Otis Maintenance organization. ● *Local* operations are conducted by 245 branch offices in 47 states, so that the men on the spot can act rapidly and effectively to give your building the best possible service. *District* and *zone* offices supervise field work and furnish supplies and emergency equipment. The *headquarters* organization provides all of the facilities and technical knowledge of the manufacturer. ● The service rendered is of such real and constant value that Otis Maintenance has more than doubled in volume every ten years. It could not thus increase without bringing the customers more than a dollar's worth of service value for every dollar spent. ● Otis Maintenance is a complete, flat-rate service for Otis elevators. It is available through your local Otis Elevator Company office.

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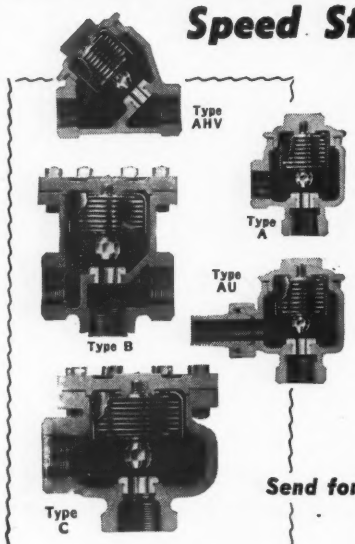
6 "Power-full" Reasons Why NICHOLSON TRAPS Speed Steam Circulation



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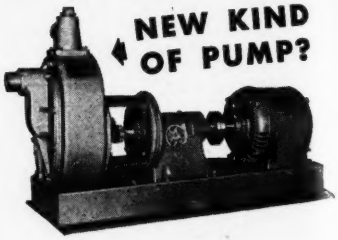

SELF-PRIMING, even on high suction lifts. Has no auxiliary priming devices. Gravity flow to the pump is not required. Reliable for continuous or intermittent service.

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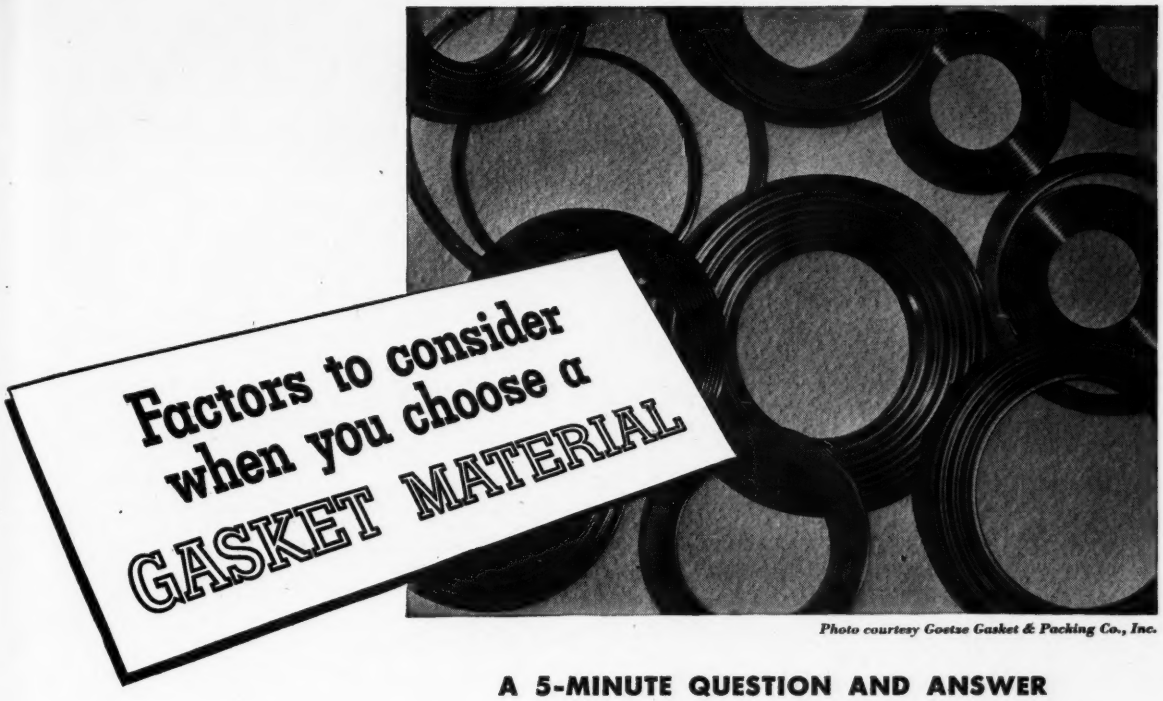

Photo courtesy Goetze Gasket & Packing Co., Inc.

A 5-MINUTE QUESTION AND ANSWER DIGEST ON GASKET SELECTION

Q. How many kinds of gasket material are there?

A. A wide variety of substances are used for gaskets. In general, they can be classified into three groups—non-metallic, semi-metallic and metallic.

Q. What determines the type of gasket material to be used for a specific application?

A. The temperature and corrosive nature of the application. Non-metallic gaskets are generally used only when temperatures don't go above 250°F. Semi-metallic gaskets—usually metal-clad asbestos—are useful up to 850°F. For higher temperatures, only all-metal gaskets are satisfactory in high-pressure steam lines.

Q. What factors control the choice of a metal for high-temperature gasket applications?

A. Suitability of a metal for high-temperature gasketing service is determined by a combination of five physical properties.

Q. What are these properties?

A. Creep strength, ductility, corrosion resistance, thermal endurance and freedom from embrittlement.

Q. What is creep strength?

A. Under stress at elevated temperatures, metals slowly creep or flow. That is why strength figures for a metal or alloy based on tests made at room temperature are of little value when you are choosing a high-temperature gasket.

Q. Why is ductility so important?

A. When a gasket is installed, the gasket material must "flow" into irregularities of the flange faces to ensure a tight seal. *Ductility* is the property that enables a metal to do this.

Q. If only an edge-area of the gasket is exposed to the confined fluid, why is corrosion resistance important?

A. Once corrosion starts, the area under attack increases rapidly until leaks develop. Moreover, if the gasket corrodes or rusts, freezing of the gasket to the flange face means a tough, expensive replacement job.

Q. What is the importance of thermal endurance?

A. As temperatures rise above 400°F. they can readily burn the life out of ordinary metals. For high-pressure steam lines, you need a metal that may have to stand temperatures *more than twice as high.*

Q. What causes embrittlement?

A. Some metals become brittle when they are subjected to alternate cycles of heating and cooling. Cracks develop and finally whole pieces of the gasket break away. Although not every gasket installation undergoes these temperature changes, a metal's ability to stand them should be given careful consideration.

Q. Are there any metals that stand up well under these conditions?

A. One of the most suitable metals for high-pressure, high-temperature gasketing is Monel. It is as strong as steel, with the added feature of good ductility. It resists attack by steam, condensates, salt water and high temperatures. And it does not become brittle.

Q. What types of gasket are available in Monel?

A. All types—corrugated, serrated or plain. In addition, any practical shape, size or construction can be readily made in Monel by leading gasket manufacturers.

Q. How about the price of Monel gaskets?

A. Because *one* Monel gasket will outlast *several* made of less suitable materials, the cost alone will be considerably less. There is also a further saving in labor charges for replacements of cheaper gaskets and lost operating time. For example, in one steam installation operating at 1400 psi. and 850°F., Monel gaskets have lasted *more than 6 years without a single replacement.*

Q. How can I get more information to guide my selection of gaskets?

A. "Choosing a Gasket," an article prepared by the engineering staff of the Goetze Gasket and Packing Company, Inc., is available upon request. Just write: The International Nickel Company, Inc., 67 Wall St., New York 5, N.Y.

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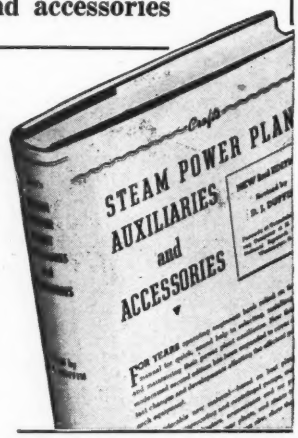

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POWER PLANT *Construction News*

Calif., Bakersfield—Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., will have plans prepared by Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., consulting engineer, for proposed new steam-electric generating station near Bakersfield, recently referred to in these columns, and same company also will supervise construction. Work is scheduled to begin in October. Cost reported close to $10,000,000.

Calif., Pasadena—City Council, City Hall, has rejected all bids recently received for two two-unit substations, 300-kva capacity, including transformers, forced air-cooling equipment, oil circuit breaker and accessories. New bids will be asked in near future.

Calif., Redwood City—Plant Rubber & Asbestos Works, 537 Brannan St., San Francisco, Calif., mechanical rubber goods, etc., plans installation of electrical power equipment in new plant at Redwood City for production of asbestos-cement building products. It will comprise several units, estimated to cost close to $1,000,000. Proposed to begin work soon. Leland S. Rosener, 233 Sansome St., San Francisco, is engineer. Company is a subsidiary of Paraffine Companies, Inc., 475 Brannon St., San Francisco.

Fla., Keystone Heights—Clay Electric Cooperative, Inc., plans new power plant, location and type soon to be determined. Fund of $548,000 has been arranged through Federal aid for this and construction of transmission and distribution lines.

Ill., Elgin—Elgin National Watch Co. has plans for new boiler house at factory, reported to cost close to $75,000, with boilers and auxiliary equipment. Proposed to begin work soon. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Ind., Indianapolis—Indianapolis Power & Light Co., 17 North Meridian St., plans addition to water-treatment plant, with installation of equipment for large increased capacity. Cost reported over $200,000. Proposed to begin work soon.

Ind., Peru—Board of Public Works, City Hall, plans expansion and improvements in municipal steam-electric generating station, with installation of turbine-generator unit and other equipment to increase capacity from 8000 to 20,000-kw. Cost estimated close to $1,000,000. Bevington, Taggart & Fowler, Inc., Indiana Pythian Bldg., Indianapolis, Ind., is consulting engineer.

Kan., Beloit—Beloit Light Department plans extensions in municipal power station, including installation of new Diesel engine-generator unit and auxiliary equipment. Also will make improvements in waterworks. Financing in part will be arranged through Federal aid. Wilson & Co., 233 North Santa Fe St., Salina, Kan., are consulting engineers.

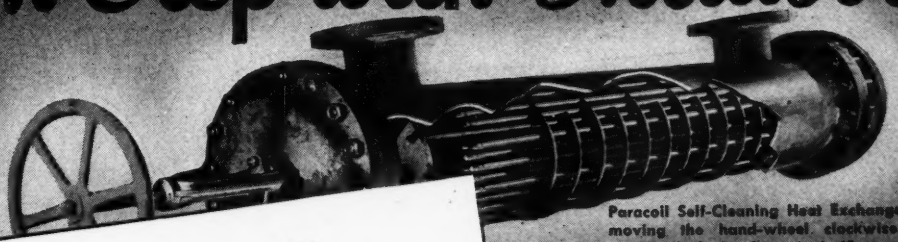
Kan., Ulysses—Pioneer Cooperative Association, Ulysses, plans new generating station, with capacity of about 3000-kw. Organization has arranged financing in amount of $1,130,000 through Federal aid for this and construction of about 350 mi. of primary and secondary lines. Proposed to begin work soon.

Mass., Holyoke—Parsons Paper Co., bond, ledger and other papers, plans installation of electric power equipment in connection with expansion and improvements in mill, including several additional buildings. Entire program reported to cost about $500,000. Proposed to begin work soon.

Minn., Starbuck—Village Council is reported planning new municipal power station and electrical distribution system. Proposed to use Diesel engine-generator unit and accessories. Estimates of cost will be made soon.

Mo., Joplin—Empire District Electric Co., 602 Joplin St., plans expansion and improvements in plants and system, including generating plants, power substations, transmission and distribution lines. Entire program will cost about $5,000,000, with equipment. Proposed to begin work soon.

In Step with Industry



Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

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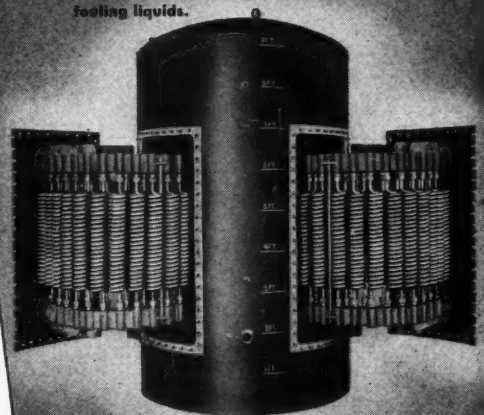
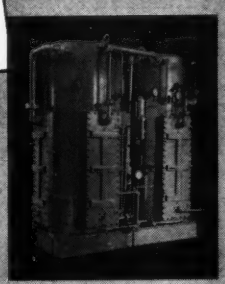
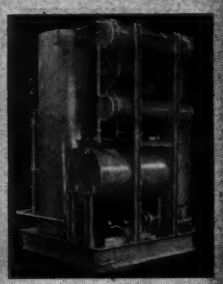


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



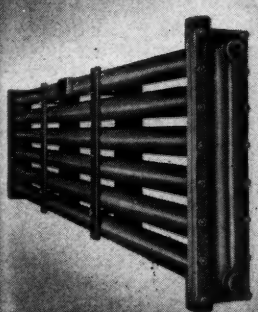
FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

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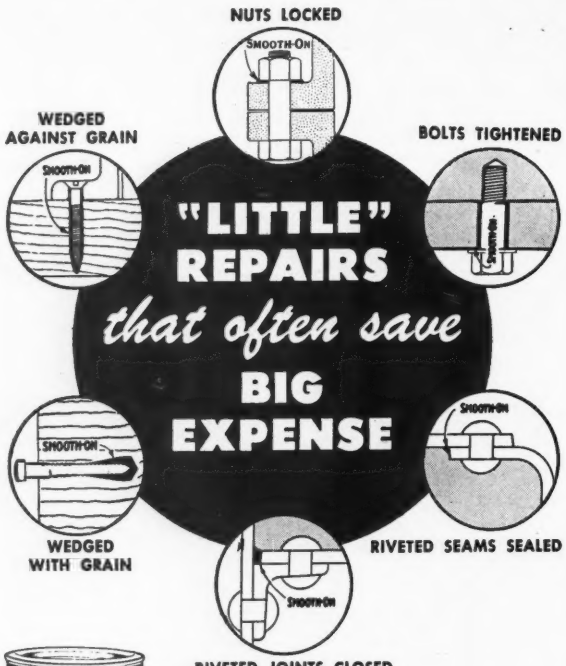

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N. J., Union—Pure Carbonic, Inc., 60 East 42nd St., New York, N. Y., plans installation of electric power equipment in proposed new dry ice manufacturing plant on Lehigh Ave., Union, where site is being secured. A boiler house is planned. Entire project reported to cost about $1,000,000. Company is a subsidiary of Air Reduction Sales Corp., first noted address.

Ohio, Ashtabula—Electro Metallurgical Co., 30 East 42nd St., New York, N. Y., plans power plant and dust control system at calcium carbide plant at Ashtabula, formerly held by Government and recently purchased from WAC. This is part of improvement program to be carried out at works, idle for number of months past, entire development reported to cost over $6,000,000. Company is a subsidiary of Union Carbide & Carbon Corp., first noted address.

Ohio, Bellevue—New York, Chicago & St. Louis Railroad Co., Terminal Tower Bldg., Cleveland, Ohio, has plans for new multi-story boiler house at shops at Bellevue, 45 x 80 ft, for which superstructure will begin soon. Cost reported over $80,000, with boilers and auxiliary equipment.

Ohio, Painesville—Glenn L. Martin Co., Plastics and Chemical Division, Middle River, Baltimore, Md., plans installation of electric power equipment in proposed new plant at Painesville for production of synthetic resins. It will comprise several large buildings. A boiler house and power substation are planned. Entire project reported to cost close to $1,500,000. Proposed to begin work soon.

Okla., Hugo—Town Council, Hugo, plans early call for bids for new Diesel engine-generator unit, about 225-hp rating, for standby service in connection with waterworks station improvements. Also for pumping machinery and auxiliary equipment for new station for water supply. Entire project reported to cost about $105,000. Alexander & Pollard, Terminal Bldg., Oklahoma City, Okla., are consulting engineers.

Ore., Oregon City—Oregon Livestock Cooperative, Inc., 509 Main St., J. G. Kassner, secretary-treasurer, plans boiler house in connection with new meat-packing plant on local site. Power equipment will be installed for factory service. Entire project reported to cost about $100,000. Annand & Kennedy, Central Bldg., Portland, Ore., are architects.

Tenn., Chattanooga—E. I. duPont deNemours & Co., Nylon Division, duPont Bldg., Wilmington, Del., plans installation of electirc power equipment in new mill at Chattanooga. It will comprise several large units. A power house is planned. Entire program reported to cost over $1,700,000. Work will be placed under way soon.

Texas, Dallas—Dallas Power & Light Co., 1506 Commerce St., plans new power sub-station on local site. Cost reported close to $585,000, with transformers, switchgear and auxiliary equipment.

Va., Parksley—Accomack Northampton Electric Corp., Parksley, plans extensions in generating station, including installation of new 650-kw Diesel engine-generator unit and auxiliary equipment. Proposed to begin work soon. Financing in part has been arranged through Federal aid, totaling $80,000.

Wash., Seattle—Seidelhuber Iron & Bronze Works, 1521 Dearborn St., ornamental iron, bronze and other metal products, plans installation of electric power equipment in new one-story sheet mill, 200 x 1200 ft. Five oil-fired furnaces and auxiliary equipment will be installed; also five 20-ton electric traveling cranes. Entire project will cost close to $1,000,000. Freyn Engineering Co., 58 East Washington St., Chicago, Ill., is consulting engineer; Engineering Associates, Polson Bldg., Seattle, are assistant engineers.

Wis., Menominee—Lakeside Aluminum Co. plans new boiler house at plant, about 40 x 50 ft, with 70-ft stack. Installation will include boilers, pumps and auxiliary equipment. No estimate of cost announced.

Wis., Milwaukee—Hummel & Downing Co., 1514 East Thomas Ave., paper boxes and containers, has taken out a permit for addition to boiler house at factory, with installation of boiler and auxiliary equipment. Work will begin soon on superstructure. No estimate of cost announced. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

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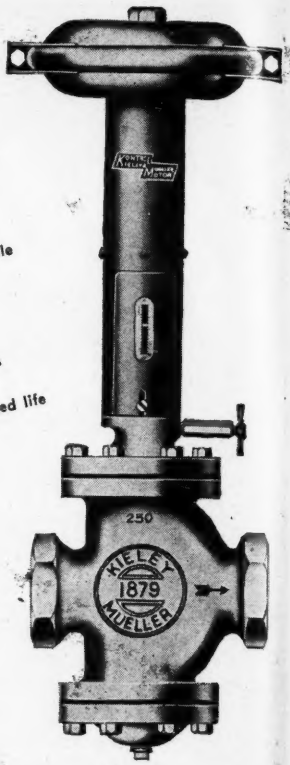

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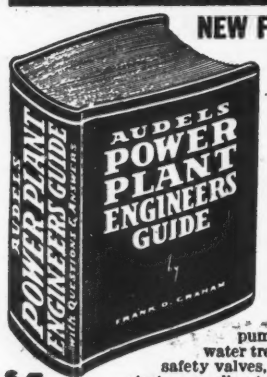

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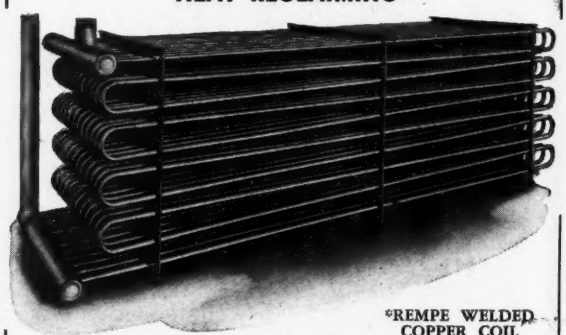

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Consult with our engineers—quotations gladly submitted on receipt of blue prints or specifications.

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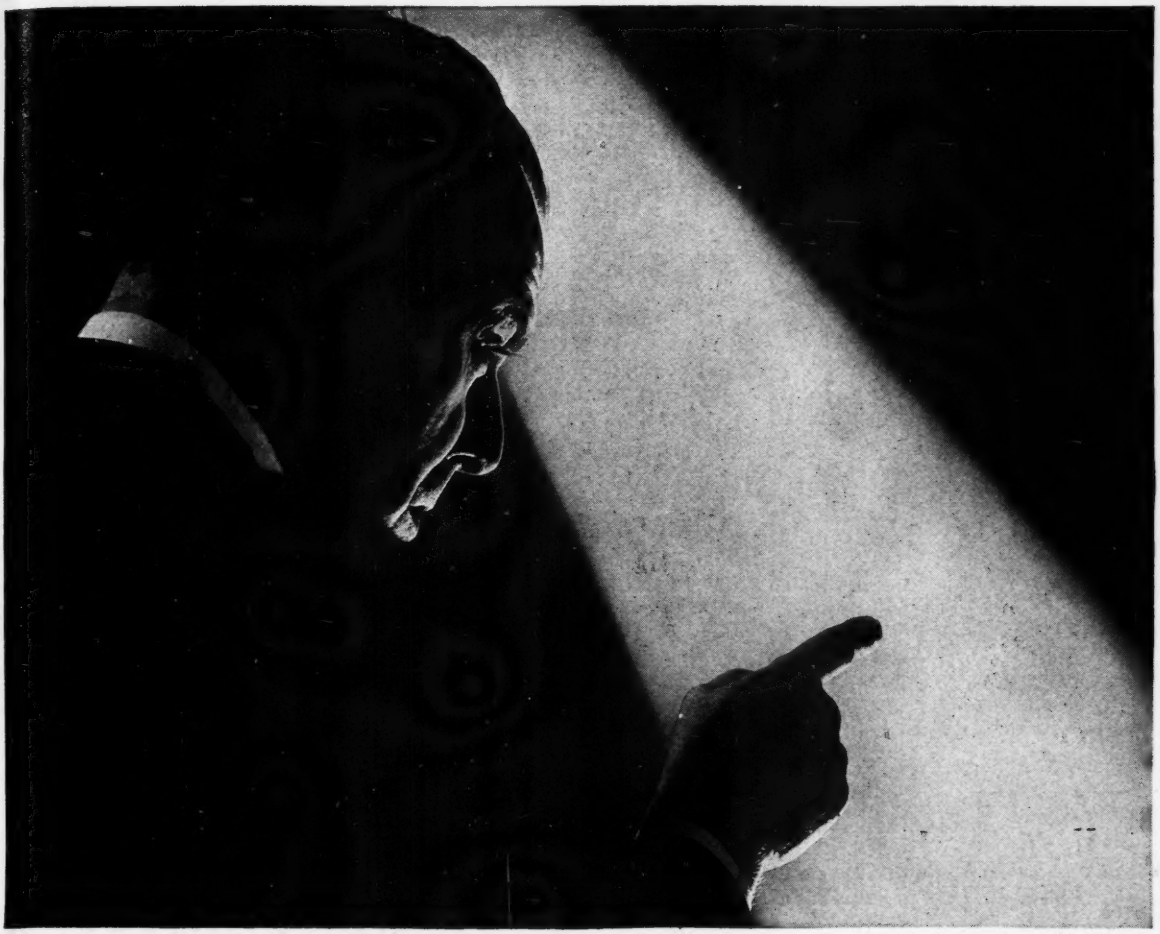

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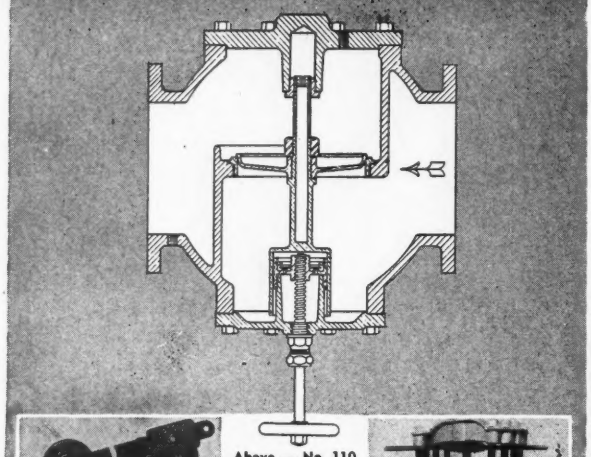
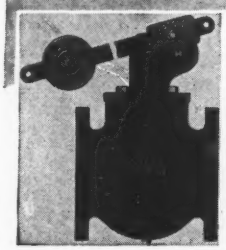
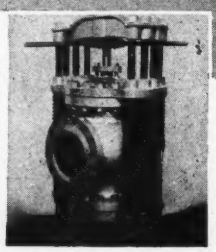
BULK MATERIAL HANDLING EQUIPMENT

DAVIS AUTOMATIC RELIEF VALVES





Above — No. 110 Exhaust Relief Valve for condenser protection service.
Left — No. 80 "Noiseless" semi-balanced Back Pressure Valve for Exhaust lines.
Right — No. 265 Turbine Bleeder and High Pressure Relief Valve.



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Angle design available as well as horizontal and vertical, also valve that will function as a relief valve part of the time and back pressure valve at other times, or with hold-open attachment so that valve must be closed manually once it has relieved.

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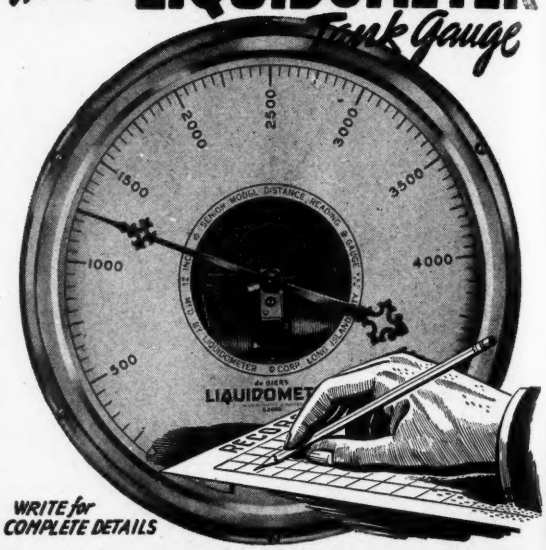

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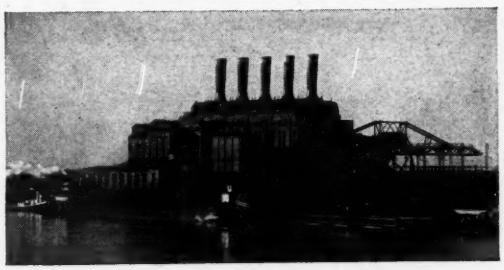

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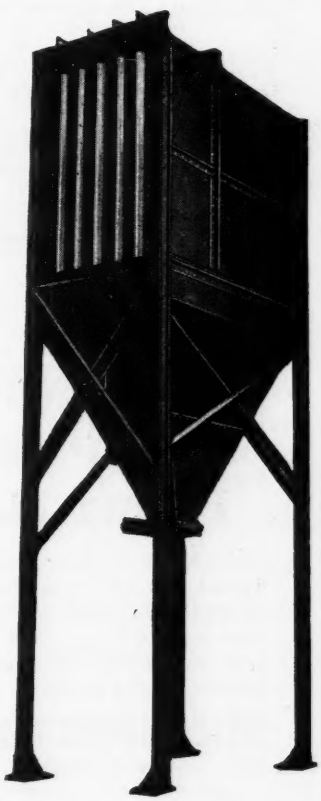

NOTE THESE REPEAT ORDERS!—Boston Elevated Ry. Co.—Brooklyn Edison Co.—Calco Chemical Co.—City of Fort Wayne, Ind.—City of Wyandotte, Mich.—Continental Paper Co.—Defense Plant Corp.—Eastman Kodak Co.—Fitchburg Gas & Electric Co.—General Electric Co.—Hudson Coal Co.—Interboro Rapid Transit Co.—Knott Hotels Corp.—Lorain Steel Co.—New York Navy Yard—Pennsylvania Power & Light Co.—Pennsylvania R.R. Co.—Peoples Gas & Electric Co.—Phoenix Utility Co.—Pullman-Standard Car Mfg. Co.—Scranton Electric Co.—Stone & Webster Engineering Corp.—J. G. White Engineering Co.

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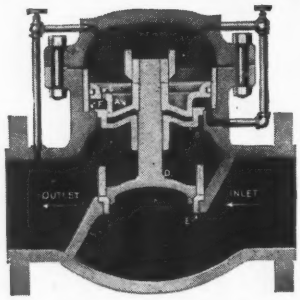

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MODEL YRF

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ONE OF THE FEATURES Responsible for Its Overwhelming Preference by Leading Diesel Manufacturers and Operators

Spring-balance principle assures lastingly dependable service. No field adjustments or settings are required to take care of gauge drifting, or to compensate for other instrument characteristics and engine conditions.

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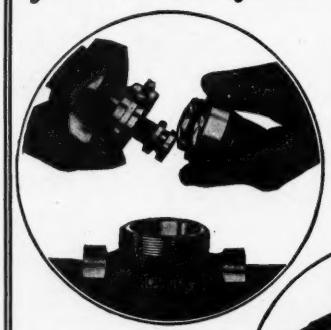
Use VULCODISC

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle — tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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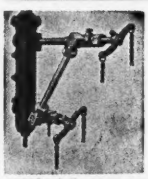

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for Boilers, Tanks, Etc.

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FIG. 4-F

FIG. 13

FIG. 9

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—with CRYSTOLON BRICK

(left) CRYSTOLON Brick after three years of service in a school boiler furnace look the same as the day they were installed.

(right) Unretouched photograph of the same CRYSTOLON Brick after 12 years of service. When soot was scraped way, the surface of the brick was found to be in perfect condition.

CRYSTOLON Brick are densely made of silicon carbide plus a minimum of a refractory bond. These highly refractory brick are physically rugged, chemically inert and resistant to abrasion. Coal ash slag cannot penetrate the hard, dense surface of CRYSTOLON Brick and this makes clinker removal a short, easy operation as well as guaranteeing long, trouble-free service.

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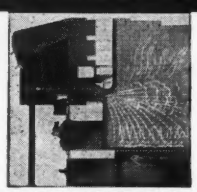

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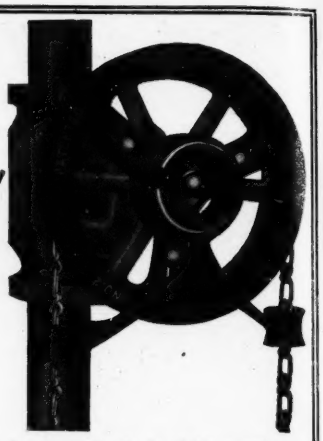

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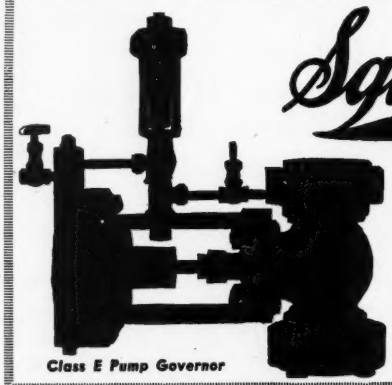

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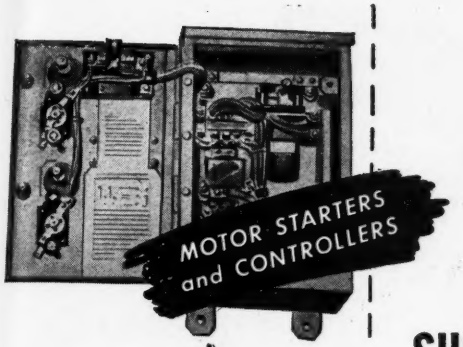

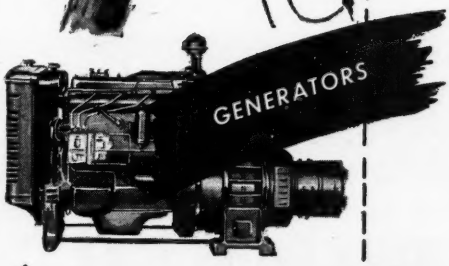

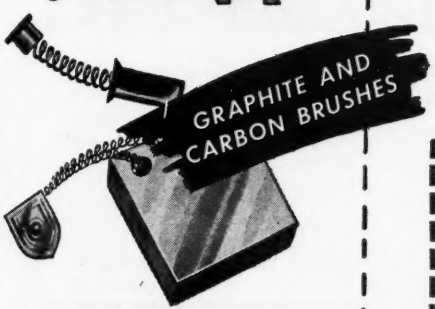

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319-3

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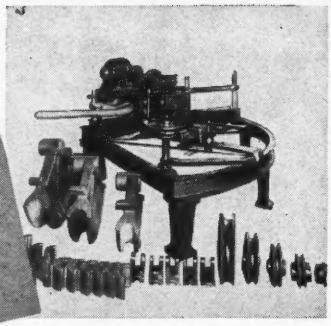

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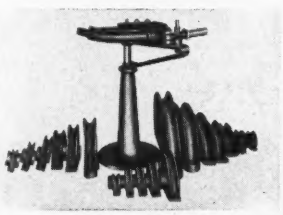

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Finish with MAGIC BOILER PRESERVATIVE

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Other methods take out the insoluble salts but introduce an equivalent amount of sodium salts. This may lead to pitting and alkali embrittlement.

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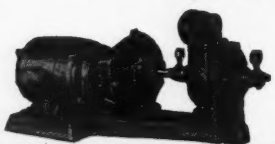

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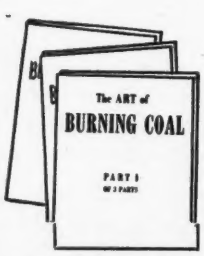

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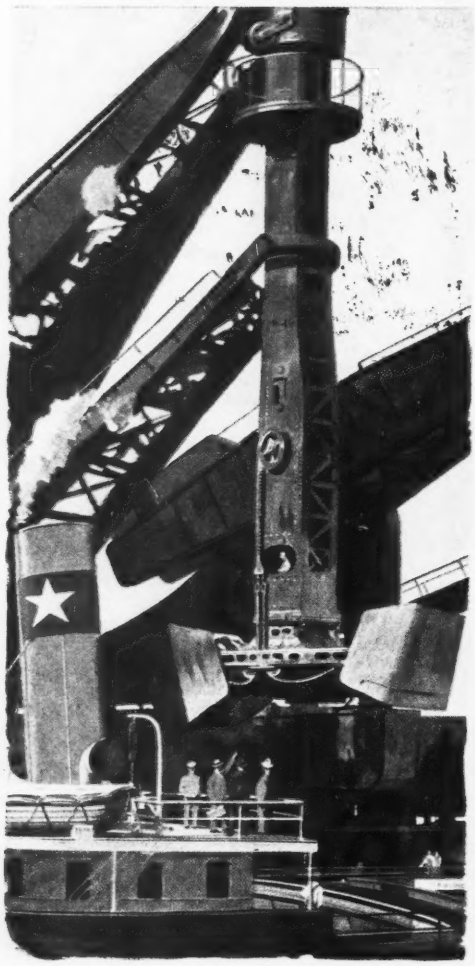

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